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The

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## EDITORIAL

## HUMAN WASTE AND AGRICULTURE

MANY factors contribute to the progressive depletion of plant foods from cultivated land. Some of them are variable, and the intensity of their action may be reduced to negligible proportions by good husbandry. But one form of soil impoverishment, the absorption and assimilation of nutriment by the growing plant and its eventual withdrawal in the form of a crop, is implicit in the very purpose of cultivation and is therefore unavoidable. One crop may be cited as an illustration, not because of its superior voraciousness but because of its importance. It has been estimated that a one-hundred-bushel crop of rice removes from the soil in which it grows the following approximate quantities of the three principal elements of plant food.

Nitrogen = 155 pounds
Phosphorus = 18 pounds
Potassium = 95 pounds

This drain cannot be arrested: it must be remedied by restoration. The penalty of failure is the exhaustion of the soil followed by the physical deterioration and the eventual extinction of the race.

Until the use of mineral fertilizers was developed in very recent times by countries which practise commercial agriculture, the only method known to man of giving back to the soil what he took away from it was the application of organic waste. The success with which any country maintained a dense population with undiminished virility depended upon the thought and labour which the farmer expended on this agricultural practice. Measured by this standard, the Mongolian races of East Asia have through the ages proved themselves to be the best farmers of the world. With a density of population which is equal to three

persons to the acre of cultivated land, the Japanese, the Korean and the Chinese betray no signs of devitalization. The agricultural methods which have given such enduring qualities to the Mongolian races merit our serious consideration.

In his very readable book, *Farmers of Forty Centuries*, Dr. F. F. King of the United States Department of Agriculture gave a very full account of the energy and resourcefulness which the Mongol races applied to the conservation and use of organic waste, and no form of waste received more attention than human excrement. Its use is practically universal. To dispel the possible hasty impression that the contribution that this waste product can make to the soil in the form of manure is trifling in volume, Dr. King quotes from analyses made by scientific workers that the estimate of the average annual production per million of adult population is 5,794, 300 pounds of nitrogen, 1,825,000 pounds of potassium and 775,600 pounds of phosphorus carried in 456,250 tons of excreta. The rest of the world has now been aware of the ancient Chinese and Japanese practice for some time. But both the realization of the danger of applying untreated human waste, probably carrying swarms of intestinal parasites, direct to the soil, and the natural unwillingness to handle this form of matter which mankind generally entertains have stood in the way of the general adoption of this practice.

The work done by Sir Albert Howard in India has succeeded in finding a simple and inexpensive process for rendering night soil safe and fit for use in agriculture. In composting not only are the objectionable qualities of the material removed while its fertilizer elements are conserved but used as what is commonly known as a " starter " it accelerates the breakdown of the more obdurate forms of farm waste. We reproduce in this number an account by Dr. J. W. Scharff of trials carried out in Malaya for adapting Sir Albert Howard's process to local conditions, and these adaptations appear to be eminently suitable for Ceylon. It is believed that local authorities which are responsible for sewage conservancy in towns are ready to undertake composting on a large scale. It is the consumer, the farmer who will pay something above the cost of production of the manure and use it on his land, who has not yet emerged. Perhaps the cessation of the import of mineral fertilizers will produce the consumer.

# EXPERIMENTS ON ASSOCIATED GROWTH OF LEGUMINOUS AND NON-LEGUMINOUS CROPS—I

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IN peasant agriculture in the tropics, it is a common practice existing from early times to grow a mixture of annual crops, particularly of legumes and non-legumes. From the standpoint of present day arable farming in temperate countries, this system is generally regarded as primitive and the precursor of mono crop cultivation on a rotational sytem.

However, many advantages are now claimed for this system, especially when the unit of land available for cultivation is small and several different crops are to be raised in the season. It enables the maximum utilization of the land and provides for the fullest use of the available plant food in the soil, since the different crops in the mixture would be feeding at various depths in the soil and absorbing different proportions of plant food. Economy of labour in sowing and cultivation can be effected, while losses from pests and diseases can be reduced. It is also possible to prevent to some extent soil erosion and weed growth, especially when erect and procumbent varieties are grown in mixture. There is, furthermore, the advantage that, when an unfavourable season prevails, one crop in the mixture is likely to grow better than another and there would be no total failure as there might be if a single crop was grown on the land.

Modern methods of mechanized farming do not readily lend themselves to the requirements of mixed cropping, but, in the tropics at least, such methods are not likely to be introduced for a long time.

The mixture may consist of a variety of types—annuals and perennials, erect and prostrate, early and late maturing, leguminous and non-leguminous crops. There may be a large number of components in a mixture and the relative proportions of these may vary considerably.

Leguminous crops may be grown either in a rotation or in association with non-legumes. In the former case, the beneficial effect of the legume on the non-legume is due to the fact that, when the legume has completed its growth, nitrogen becomes available in the soil as a result of the decay of the nodules and the roots. When legumes and non-legumes are grown in association, Virtanen and his associates (1933, 1937 and Nicol (1936) claim that the legumes excrete organic nitrogen from their developing nodules which is utilized by the non-legume during its growth. On the other hand, a number of other investigators such as Trumble and Shapter (1937), Wilson and Burton (1938), Shapter (1939) and Wyss and Wilson (1941) have not been able to confirm these findings. Apparently, certain environmental factors govern the excretion or otherwise of nitrogen from the legumes, but what these are and how they operate are not clearly understood. If the environmental conditions are such that the leguminous species fixes more nitrogen than is required for its development, then nitrogen accumulates in the nodules and is excreted (Wyss and Wilson 1941). Some workers *e.g.*, Madhok (1940) and Papadakis (1941) have found that the yields of the legume are depressed as a result of the association. This may be due to the fact that the non-legumes use up much of the nitrogen that the legumes have fixed to the detriment of the latter. The beneficial effect on the non-legume may also be determined by a suitable combination of legume and non-legume. Madhok (1940) reports that while sorghum benefits by association with the cluster bean (*Cyamopsis psoraloides*) wheat, on the other hand, does not show any marked or consistent beneficial effect when grown in association with gram (*Cicer arietinum*).

Nevertheless, legumes and non-legumes are frequently cropped together. Even in temperate countries pastures consist of grasses and cloves in suitable mixtures. Cereals and pulses in the tropics are commonly mixed. Nicol (1935) has given many instances of these in India and elsewhere. Barley or wheat and gram are frequently grown together in the North-West Frontier Province, wheat and gram in the Punjab, cumbu (*Pennisetum typhoideum*) and dhal or horsegram, sorghum and cluster bean in the Bombay Presidency. Rangasamy Ayyangar and Sankara Ayyar (1941) report that sorghum is grown with various pulses such as dhal, gram, green gram and cowpea in the Madras Presidency. In Mysore State, kurakkan is associated with *motchchai* (*Dolichos lablab*) or horsegram, while in the chenas of Ceylon (jungles cleared for shifting cultivation) *kurakkan* is grown as the main crop with green gram, maize, chillies, mustard and *Amaranthus* sp. (*S. tampala*). In West Africa, sorghum is grown with cowpea

(Irvine 1934) and in East Africa, maize with various legumes such as French beans (*Phaseolus vulgaris*), cowpea, green gram and groundnuts (Robertson 1941).

From the practical standpoint what is important is to determine whether it is more economical to grow crops of cereal and legumes in association than in separate plots of half the unit area. There is a scarcity of field experimental data on this point. The most extensive series of experiments so far carried out are those of Papadakis (1941) in Greece. He found that the yield of a cereal crop in a mixture with a legume was about 60 per cent. more than the yield produced on half the area of the cereal when sown alone, while the yield of the leguminous crop was about equal to that of half the area sown with the legume alone.

With the object of obtaining some definite information on the subject of associated growth under Ceylon dry zone conditions, preliminary experiments were commenced at the Agricultural Station, Dambulla, in the *maha* 1938–39 season, the cereal and legume crops being *kurakkan* and green gram respectively. The effect of liming was examined at the same time. The residual effect of the different treatments was tested by growing gingelly on all the plots in the following *yala* season. The experiment was repeated in the *maha* 1939–40 and *maha* 1940–41 seasons with certain modifications in the treatments. In the first year, the *kurakkan* failed owing to the drought, and in the second year, severe damage by grasshoppers in certain plots and water-logging in others during November again resulted in the failure of the *kurakkan* and thus of the whole experiment. In the *maha* 1940–41 season, conditions were generally satisfactory and the experiment was successfully carried out. The following were the treatments :—

(1) *Kurakkan* (K) drilled in rows 9-in. apart
(2) Green gram (G) ditto.
(3) *Kurakkan* and green gram ($K_1$ $G_1$) drilled in alternate rows 9 in. apart.
(4) *Kurakkan* and green gram ($K_2$ $G_2$) drilled in two rows of *kurakkan* 6 in. apart alternating with one row of green gram 9 in. between the rows of *kurakkan*.
(5) *Kurakkan* (L K) as in 1 above, but with lime applied at the rate of 1 ton per acre.
(6) Green gram (L G) as in 2 above but with lime at 1 ton per acre.
(7) *Kurakkan* and green gram (L $K_1$ $G_1$) as in 3 above but with lime at 1 ton per acre.
(8) *Kurakkan* and green gram (L $K_2$ $G_2$) as in 4 above but with lime at 1 ton per acre.

The treatments were replicated in 5 randomized blocks. The soil of the area is a fairly deep, medium loam, well-supplied with plant nutrients generally, and of neutral to slightly alkaline reaction.

Pure line *kurakkan* (E 43) and a local variety of green gram were used. The experimental area was ploughed on September 9, 1940, and manured with compost at 6 tons per acre on September 20. On October 12, the land was harrowed with a disc harrow, followed by a spiked tooth harrow. Lime was applied to the plots receiving this treatment on October 20 at the rate of 1 ton per acre. The plot size was 1/48 acre. The crops were sown on October 29 and 30, and the kurakkan was thinned out on November 25. A considerable amount of damage in the plots in Block No. 5 was caused by attacks of elephant, wild pig and monkeys and the yields from this block were, therefore, omitted from the calculations.

Harvesting of the green gram took place on December 25, and of *kurakkan* on February 2–7, 1941. The results which have been subjected to statistical analysis are given below :—

TABLE I.

MEAN YIELD OF KURAKKAN PER PLOT

| Treatments. | No lime. | Lime. | Mean. | Bushels per acre. |
|---|---|---|---|---|
| | lb. | lb. | lb. | |
| *Kurakkan* (K) | 42·7 | 45·5 | 44·1 | 33·0 |
| *Kurakkan* and green gram (K $G_1$) | 35·7 | 38·7 | 37·2 | 27·6 |
| *Kurakkan* and green gram (K $G_2$) | 32·2 | 39·3 | 35·8 | 26·9 |
| Mean | 36·8 | 41·5 | | |

| Significant difference | | Mean lb. per plot | Mean Bushels per acre |
|---|---|---|---|
| (1) Liming Vs. no liming | P = ·05 | 4·75 | 3·6 |
| (2) Crop treatments | P = ·05 | 5·8 | 4·3 |
| | P = ·01 | 6·7 | 5·0 |

TABLE II.

MEAN YIELD OF GREEN GRAM PER PLOT

| Treatments. | No lime. | Lime. | Mean. | Bushels per acre. |
|---|---|---|---|---|
| | lb. | lb. | lb. | |
| Green gram (G) | 10·7 | 8·9 | 9·8 | 7·3 |
| *Kurakkan* and green gram (K $G_1$) | 3·7 | 3·8 | 3·8 | 2·8 |
| *Kurakkan* and green gram ($K_2$ G ) | 2·4 | 2·6 | 2·5 | 1·8 |
| Mean | 5·6 | 5·1 | | |

It will be seen that the pure *kurakkan* ($K_1$) treatment has given significantly higher yields of *kurakkan* than the mixed kurakkan and green gram treatments ($K_1$ $G_1$ and $K_2$ $G_2$). There is no significant difference in yield between the two latter treatments, viz. : $K_1$ $G_1$ and $K_2$ $G_2$.

The yields of green gram were not subjected to statistical analysis, as it is clear that the pure green gram treatment is superior to the other two.

Liming has had no effect on the yield of green gram but there are indications of some beneficial effect on the *kurakkan* though statistical significance at the 5 per cent. point has not been reached. The reason for this poor response to liming is due to the fact that the soil was of high calcium status. The average $P_H$ of the unlimed plots was 7·63, and of the limed plots 8·21, the calcium oxide contents being 0·86 and 0·96 per cent. respectively. The analysis of samples of *kurakkan* grain and green gram seed from the limed and unlimed plots showed little differences in respect of the lime, phosphoric acid and protein contents.

### THE ECONOMICS OF MIXED CROPPING UNDER THE EXPERIMENTAL CONDITIONS

On examining the yields of the crops grown pure and in association, it will be seen that :—

| | | lb. |
|---|---|---|
| 1. | One unit of *kurakkan* (K) gave .. .. | 44·1 of K |
| | and one unit of green gram (G) gave .. .. | 9·8 of G |
| 2. | Two units of *kurakkan* and green gram grown .. | 74·4 of K |
| | in alternate rows ($K_1$ $G_1$) gave .. .. | 7·6 of G |
| 3. | Two units of *kurakkan* and green gram .. .. | 71·6 of K |
| | grown with 2 rows of K alternating with one row of G ($K_2$ $G_2$) gave .. .. .. | 5·0 of G |

These results indicate that two units of a mixture of *kurakkan* and green gram produce about 70 per cent. more cereal grain than one unit of the cereal alone and about 25 per cent. less gram than one unit of the pulse sown alone. Papadakis (1941) obtained similar results from his field experiments in respect of the cereal yields but reported only a small average decrease of the legume. An examination of his data shows, however, that except in the case of lupins, the yield of legume was depressed to a fairly appreciable degree by the association.

If the results now obtained are confirmed by further experiments in progress, it would appear advantageous, when it is necessary to raise both a cereal and legume crop (the cereal being the more important consideration) on a definite area of land, to grow the crops in association rather than in separate plots of half the extent each. If, on the other hand, economic returns are of primary importance, the system of cropping to be adopted should be determined by the respective prices of

cereal and legume. In this instance, at the prevailing prices of *kurakkan* and green gram (Re. 1·00 per bushel of *kurakkan* and Rs. 6·00 per bushel of green gram at Dambulla), the returns from 2 acres based on the yields obtained in this experiment are indicated in Table III.

TABLE III.

| | Yield per acre. Busehls. | Value. Rs. | Total value. Rs. |
|---|---|---|---|
| 1. *Under pure cropping* | | | |
| *kurakkan* | 33·0 | 33·00 | 76·80 |
| green gram | 7·3 | 43·80 | |
| 2. *Under mixed cropping* ($K_1$ $G_1$) | | | |
| *kurakkan* | 55·2 | 55·20 | 88·80 |
| green gram | 5·6 | 33·60 | |
| 3. *Under mixed cropping* ($K_2$ $G_2$) | | | |
| *kurakkan* | 53·8 | 53·80 | 75·40 |
| green gram | 3·6 | 21·60 | |

From the point of view of economic returns and total food production, mixed cropping is, therefore, preferable to pure cropping under Dambulla conditions, but factors such as the spacing and seed rate of the components of the mixture would probably determine the result, as may be gauged from this experiment. Too high a proportion of the non-legume in the mixture would unduly depress the yield of the legume.

## RESIDUAL EFFECTS OF THE LEGUME

For the *yala* season, the experimental area was ploughed and harrowed from March 26–31, no manure being added. A variety of gingelly called Burma No. 3, a black seed selection originally obtained from Burma, was sown broadcast on April 9, on all the experimental plots in order to ascertain the residual effects of the legume in pure stand and mixed. The crop was harvested on June 18. The yield results are given in Table IV :—

TABLE IV.

MEAN YIELDS OF GINGELLY PER PLOT

| *Previous teatments* | No lime. lb. | Lime. lb. | Mean. lb. | Bushels. per acre. |
|---|---|---|---|---|
| Green gram (G) | 15·6 | 14·7 | 15·1 | 11·3 |
| *Kurakkan* (K) | 17·0 | 15·6 | 16·3 | 12·2 |
| *Kurakkan* and green gram ($K_1$ $G_1$) | 13·2 | 15·5 | 14·3 | 10·3 |
| *Kurakkan* and green gram ($K_2$ $G_2$) | 14·7 | 15·0 | 14·8 | 11·1 |
| Mean | 15·1 | 15·2 | | |

It is apparent that gingelly has shown no response to liming in the previous season nor has there been any appreciable residual effect of the legume either alone or in the mixture on

the yields of gingelly. The question of the residual effects of leguminous crops which are not grown for green manuring is being further investigated.

## SUMMARY

1. An experiment carried out at the Dambulla Agricultural Station to ascertain whether it is more advantageous to grow *kurakkan* and green gram in association than as pure crops, indicated that from the aspect of both grain production (particularly of the cereal) and economic returns, mixed cropping was preferable.

2. Liming produced no significant increases in yields of *kurakkan* and green gram, or of the subsequent crop of gingelly.

3. There were no residual effects of the legume, both alone and in mixture, on the gingelly crop.

## ACKNOWLEDGEMENT

We record our thanks to Mr. J. S. L. White, Agricultural Instructor, Dambulla, for his care in supervising the field operations in this experiment.

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# EXPERIMENTS ON THE MANURING OF CIGARETTE TOBACCO IN CEYLON

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## INTRODUCTION

IN the *maha* 1940 season a manurial trial was laid down at the Wariyapola Experiment Station to ascertain the effects of varying combinations of nitrogen and potash on the yield and quality of cigarette tobacco, the level of phosphoric acid being maintained constant.

The variety of tobacco experimented with was Harrison's Special, which has, up to now, been found most suited to the district. The soil of the area is a light sandy loam, extremely poor in nitrogen and organic matter and poor in mineral nutrients. It is of slightly acid reaction. The incidence of rainfall at the station during the period of the trial, *i.e.*, from October to early March and the average distribution are shown below :—

1940–41.

| | Inches. | Average. Inches. |
|---|---|---|
| October | 18·40 | 13·7 |
| November | 21·21 | 11·7 |
| December | 5·20 | 6·2 |
| January | 1·93 | 5·4 |
| February | 0·56 | 1·5 |
| March (1–5th) | 0·25 | 0·5 |
| | 47·55 | 39·0 |

## EXPERIMENTAL DETAILS

The manurial treatments, which consisted of combinations of nitrogen at three levels with potash at two levels, were six in number, and are detailed below.

(1) Single nitrogen (20 lb. per acre) and single potash (approx. 20 lb. per acre)—NK.

(2) Single nitrogen (20 lb. per acre) and double potash (40 lb. per acre)—N2K.

(3) Double nitrogen (40 lb. per acre) and single potash (20 lb. per acre)—2NK.

(4) Double nitrogen (40 lb. per acre) and double potash (40 lb. per acre)—2N2K.

(5) Treble nitrogen (60 lb. per acre) and single potash (20 lb. per acre)—3NK.

(6) Treble nitrogen (60 lb. per acre) and double potash (40 lb. per acre)—3N2K.

Nitrogen was applied as a mixture of nitrate of soda and blood meal, the quantities of these fertilizers per acre for the single dressing having been 100 lb. and 40 lb. respectively. These quantities were increased proportionately for the higher dressings. Potash was applied as sulphate of potash, the amount per acre for the single dressing having been 40 lb. The basal application of phosphoric acid was 30 lb. per acre in the form of superphosphate.

The experiment was laid out in six randomized blocks, each plot being of external dimensions 30 ft. by 30 ft. The net harvested area per plot was 24 ft. by 24 ft., comprising 81 plants in all. The plants were spaced 3 ft. by 3 ft. The fertilizers were applied at intervals as follows :—

One quarter, 5 days after planting.
One half, 14 days after planting.
One quarter, 21 days after planting.

The mixture was applied, suitably diluted with sand, around each plant separately.

### OTHER PRACTICAL DETAILS

The area was originally planted out towards the end of October but had to be replanted on November 19 and 20 as a result of heavy rains. The first application of fertilizer was given on November 25, 1941, the second on December 3, 1941, and the last on December 11, 1941. It was noted that the plots receiving the highest dressing of nitrogen showed greatest vigour and rapidity of growth in the early stages of crop development. At each harvest, of which there were six, records of the green weight were kept so that information could be obtained relative to the conversion ratio of green to cured tobacco. The tobacco was flue-cured.

The high yield of crop per acre obtained in this trial as compared with the average for the station can be accounted for on the following grounds :—(1) the normal application of nitrogen on the station is 20 lb. per acre, corresponding to the lowest nitrogen level in the experiment ; (2) in the trial all vacancies were filled, as far as was possible, with the best plants, and the best time of the season was selected for planting ; (3) yields are based on the maximum number of plants per unit area, while on the farm the actual extent of land under crop is appreciably less than the surface area, owing to drains, bunds, &c. ; (4) the area selected for the trial was the best available from the point of view of uniformity, good drainage, &c. On the farm certain areas are waterlogged in wet weather ; (5)

the season was generally favourable in respect of total rainfall. The average yield of crop on the station for the season is much higher than that in previous years.

## RESULTS

The data obtained from the trial is presented in a series of six tables, each of which deals with a separate aspect of the trial. In table I. below the yields of cured tobacco in pounds per plot are shown. No correction has been made in plot yield for the number of vacancies. In tables IA and IB, the results of the satistical analysis of the data are presented.

**TABLE I**
**Yields of Cured Tobacce in Lbs.**

| Treatments | Blocks. A | B | C | D | E | F | Total | Mean |
|---|---|---|---|---|---|---|---|---|
| I NK | 11·9 | 7·9 | 7·5 | 8·7 | 6·7 | 10·8 | 53·5 | 8·92 |
| II N2K | 10·8 | 6·8 | 9·4 | 5·3 | 7·2 | 7·4 | 46·9 | 7·81 |
| III 2NK | 16·3 | 10·4 | 12·8 | 6·0 | 11·2 | 9·1 | 65·8 | 10·97 |
| IV 2N2K | 16·1 | 9·0 | 10·6 | 16·1 | 9·0 | 9·8 | 70·6 | 11·77 |
| V 3NK | 13·2 | 7·8 | 14·3 | 17·6 | 12·4 | 14·1 | 79·4 | 13·23 |
| VI 3N2K | 17·7 | 10·5 | 10·3 | 17·1 | 11·5 | 14·6 | 90·7 | 15·12 |
| | 86·0 | 52·4 | 73·9 | 70·8 | 58·0 | 65·8 | 406·9 | |

General mean : 11·3 lb.

**TABLE IA**
**Analysis of Variance of Yields**

| | Degrees of freedom | Sum of sq. | Mean sq. | F |
|---|---|---|---|---|
| Treatments | 5 | 218·7 | 43·74 | 7·2 |
| Blocks | 5 | 119·1 | | |
| Error | 25 | 152·1 | 6·08 | |
| | 35 | 489·9 | | |

For P = ·05, F = 2·60
,, P = ·01, F = 3·86

Results are very definitely significant.

**TABLE IB**
**Yields in Lbs.**

| | Single nitrogen | Double nitrogen | Treble nitrogen | Total | Mean per plot | Per acre |
|---|---|---|---|---|---|---|
| Single potash | 53·5 | 65·8 | 79·4 | 198·7 | 11·04 | 662·4 |
| Double potash | 46·9 | 70·6 | 90·7 | 208·2 | 11·57 | 694·2 |
| Total | 100·4 | 136·4 | 170·1 | 406·9 | | |
| Mean per plot | 8·37 | 11·37 | 14·17 | — | 11·3 | — |
| Mean per acre | 502·0 | 682·0 | 850·5 | — | — | 678 |
| Per cent. of mean | 74·0 | 100·5 | 125·4 | — | — | 100 |

Significant differences :—

For comparisons of nitrogen treatments: 2·07 lb. or 1·83 per cent. (P = ·05), 2·84 lb. or 2·51 per cent. (P = ·01).

For comparisons of potash treatments : 1·69 lb. or 1·49 per cent. (P = ·05), 2·29 lb. or 2·03 per cent. (P = ·01).

An examination of the data of tables IA and IB will indicate that very significant increased yields are obtained as a result of nitrogenous manuring, the increases being almost proportional to the additional amounts of nitrogen applied. The yields of cured tobacco at the second and third levels of nitrogen, expressed as percentages of the mean, are over 25 and 50 per cent. higher than that at the first level. Expressed in pounds per acre, the average yield varies from 502 lb. for the single nitrogen to 850 lb. for the treble nitrogen dressing. The additional application of potash over the basal dressing of 20 lb. per acre is without effect on yield. Interactions between the nitrogen and potash treatments are not significant.

**TABLE II**

**Yields of Tobacco according to Grades**

| Grades | Treatments. | | | | | |
|---|---|---|---|---|---|---|
| | NK | N2K | 2NK | 2N2K | 3NK | 3N2K |
| I | 9·2 | 6·3 | 6·7 | 10·9 | 4·9 | 3·4 |
| | *17·2* | *15·5* | *10·2* | *15·4* | *6·2* | *3·8* |
| II | 8·2 | 7·2 | 9·5 | 13·7 | 8·3 | 7·2 |
| | *15·2* | *17·5* | *14·5* | *19·3* | *10·4* | *7·9* |
| III | 3·0 | 4·5 | 4·9 | 5·8 | 1·3 | 2·8 |
| | *5·6* | *11·1* | *7·4* | *8·2* | *1·7* | *3·1* |
| IV | 11·7 | 7·0 | 12·3 | 11·5 | 11·4 | 14·1 |
| | *21·7* | *17·2* | *18·6* | *16·3* | *14·3* | *15·9* |
| V | 10·8 | 7·0 | 14·0 | 14·7 | 21·7 | 26·2 |
| | *20·2* | *17·2* | *21·3* | *20·8* | *27·2* | *28·8* |
| VI | 6·0 | 4·1 | 6·8 | 4·3 | 8·2 | 10·3 |
| | *11·2* | *10·1* | *10·3* | *6·0* | *10·4* | *11·3* |
| VII | 4·8 | 4·7 | 11·5 | 9·9 | 23·4 | 26·8 |
| | *8·9* | *11·3* | *17·5* | *14·0* | *29·5* | *29·6* |

Figures in italics indicate percentages of the grade on total yield of crop for the particular treatment.

In table II. above are shown the yields of each of the seven commercial grades of tobacco for the different treatments. The data are yields of crop from six replicated plots. The figures in italics are percentages of the grades of tobacco on total yield of crop for each treatment.

It will be observed that the highest dressing of nitrogen results in a large outturn of poor quality tobacco. Thus, the percentages of grades V., VI., and VII. tobacco from the treble nitrogen (60 lb. per acre) treatments are 67·1 and 69·7 per cent. respectively, while the corresponding figures for the single nitrogen treatment are 40·3 and 38·6 per cent. respectively. On the other hand, the single and double nitrogen treatments give much the same outturns of good quality tobacco, *viz.*, 38·0 and 34·1 per cent. and 34·1 and 32·9 per cent. respectively

The higher application of potash does not appear to offset any ill-effects of the high nitrogen applications on quality, nor does it improve the quality of tobacco at the lower levels of nitrogen. From the points of view of both quality and yield, the double nitrogen treatments are, therefore, preferable to the single nitrogen treatments.

**TABLE III**

**Average Value in Cents per Lb.**

| Treatments | | | | | |
|---|---|---|---|---|---|
| NK | N2K | 2NK | 2N2K | 3NK | 3N2K |
| 64·7 | 67·0 | 60·7 | 64·8 | 54·1 | 51·1 |

Average for nitrogen treatments : N = 65·8, 2N = 62·7, 3N = 52·6.
Average for potash treatments : K = 59·7, 2K = 60·6

Significant differences :—

| | P = ·05 cts. | P = ·01 cts. |
|---|---|---|
| for nitrogen comparisons is | 4·2 | 5·7 |
| for potash comparisons is | 3·4 | 4·6 |
| for means of treatments is | 5·9 | 8·0 |

The average price per pound of tobacco obtained for each of the separate treatments and for each level of nitrogen and potash, has been calculated from the yields per plot obtained of each grade of tobacco and the price per pound of the grade on the following scale :—

| | Rs. | c. | |
|---|---|---|---|
| Grade I. | 1 | 0 | per lb. |
| ,, II. | 0 | 90 | ,, |
| ,, III. | 0 | 80 | ,, |
| ,, IV. | 0 | 60 | ,, |
| ,, V. | 0 | 50 | ,, |
| ,, VI. | 0 | 40 | ,, |
| ,, VII. | 0 | 30 | ,, |

These figures are shown in table III. above. The data were subjected to statistical analysis and found to be significant. The significant value differences for the various comparisons are also shown in the table.

It will be noted that (1) there is, on the average, no statistical difference in value per lb. between that of the single and double nitrogen treatments ; (2) there is a very marked and statistically significant falling off in price, viz., from 66 to 53 cts. as the quantity of nitrogen is increased from the first and second to the third level (60 lb. per acre) ; (3) increasing the potash has not led to a statistically significant improvement in the value of the tobacco produced. At the lower levels of nitrogen an increase of potash does, however, appear to have some effect on the value of tobacco ; (4) the average price per lb. of tobacco in the case of treatment III. (double nitrogen, single potash) is significantly less than that of treatment II. (single nitrogen, double potash).

TABLE IV

Gross Returns Per Acre

| Treatments | NK | N2K | 2NK | 2N2K | 3NK | 3N2K |
|---|---|---|---|---|---|---|
| Rs. | 346 | 317 | 398 | 450 | 420 | 458 |

The data in table IV. above show that the highest gross returns are obtained from the double nitrogen and potash, and treble nitrogen and double potash treatments. In view, however, of the quality and price of tobacco at the third level of nitrogen being appreciably less than that of the product at the lower nitrogen levels, the double nitrogen, double potash treatment could be considered to be the optimum under the soil and climatic conditions at Wariyapola.

TABLE V

Percentage Yields of Crop at each Harvest

| Treatments | Harvets | | | | | |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th | 6th |
| NK | 15·4 | 24·6 | 26·2 | 4·6 | 22·3 | 6·3 |
| N2K | 16·4 | 24·8 | 25·9 | 4·3 | 21·7 | 6·9 |
| 2 NK | 13·1 | 22·2 | 27·5 | 2·9 | 26·0 | 7·6 |
| 2 N2K | 15·5 | 26·3 | 27·7 | 4·2 | 20·4 | 7·6 |
| 3 NK | 12·9 | 24·5 | 23·9 | 2·2 | 28·3 | 7·9 |
| 3 N2K | 13·5 | 23·1 | 25·2 | 2·6 | 28·0 | 7·7 |

In table V. above, the calculated percentages of cured tobacco on total crop obtained at each harvest for each treatment are furnished. The data indicate that the treatments have not exerted any appreciable differential effect in respect of rate of maturity, as gauged from the total crop harvested at each harvest. The low percentage yield of crop at the fourth harvest is noteworthy.

TABLE VI

Percentage of Cured to Green Tobacco

| Treatments | Harvests | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1st Per Cent. | 2nd Per Cent. | 3rd Per Cent. | 4th Per Cent. | 5th Per Cent. | 6th Per Cent. | Average Per Cent. |
| NK | 10·7 | 15·0 | 15·7 | 14·6 | 18·2 | 19·7 | 15·6 |
| N2K | 11·1 | 15·1 | 17·6 | 13·1 | 18·2 | 18·7 | 15·6 |
| 2 NK | 10·0 | 13·6 | 17·0 | 13·6 | 18·0 | 18·2 | 15·1 |
| 2 N2K | 10·0 | 14·0 | 16·6 | 14·4 | 18·8 | 18·0 | 15·3 |
| 3 NK | 9·4 | 14·6 | 16·0 | 14·0 | 17·8 | 19·3 | 15·2 |
| 3 N2K | 9·5 | 13·4 | 16·0 | 13·3 | 18·1 | 19·7 | 15·0 |
| Average | 10·1 | 14·3 | 16·5 | 13·8 | 18·2 | 18·9 | 15·3 |
| Date of harvest | 23/1 | 3/2 | 10/2 | 18/2 | 25/2 | 5/3 | |
| Rainfall for period between harvests | 1·93 | — | ·56 | — | — | ·02 | |

The percentages of cured to green tobacco at each harvest for each treatment are set out in table VI. The interesting point which emerges from the data is that the percentages, except in one instance, increase from 10·1 to 18·9 as the season advances. In the case of the exception referred to, the fourth harvest the yields of crop harvested were so very low as compared with those of the harvest immediately before and after, that any figures obtained therefrom cannot be considered truly representative. These results need no explanation and are as to be expected. The percentage figures are not in any way correlated to the rainfall prior to or between harvests.

## GENERAL

These results, in respect of yield and quality of crop as affected by fertilizer treatment, generally confirm those obtained in Rhodesia (1). The quantities of nitrogen applied in our trial are, however, appreciably higher than those in the Rhodesian experiments. The reverse is the case with potash. Further trials on similar lines to the one under discussion are contemplated at two centres next *yala* season.

## SUMMARY AND CONCLUSIONS

A manurial trial conducted at the Wariyapola Experiment Station during the *maha* 1941–42 season to determine the effects of combinations of nitrogen and potash at different levels on the yield and quality of cigarette tobacco have indicated that :—

(1) Yields increase proportionately with the additional amounts of nitrogen applied, the rate of increase being about 25 per cent. of the mean yield for each unit of nitrogen (20 lb. per acre) given.

(2) An additional application of potash (20 lb. per acre) over the basal dressing (20 lb. per acre) is without effect on yield.

(3) The highest dressing of nitrogen (60 lb. per acre) reduces the percentage outturn of the higher grades and increases appreciably the percentage of the lower grades of tobacco.

(4) There is a marked falling off in the average value per pound of the cured tobacco as the quantity of nitrogen is increased from the first and second to the third level. Increasing the potash, has not affected any improvement in quality of tobacco.

(5) The highest gross returns are obtained from the treble nitrogen, double potash and the double potash, double nitrogen treatments.

(6) From the point of view of both yield and quality of tobacco at Wariyapola, the optimum manurial dressing would appear to be 40 lb. nitrogen and 40 lb. potash per acre.

(7) Manurial treatments do not appear to affect to any appreciable degree, the percentage yields of crop at each harvest on total crop harvested.

(8) The outturns of cured to green tobacco increase with advancing season.

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# PSEUDO FOWL PLAGUE

**M. CRAWFORD, M.R.C.V.S.**
*GOVERNMENT VETERINARY SURGEON*

THIS is the most serious infectious disease of poultry in Ceylon at present and is doing more to hinder the development of a promising cottage industry than any other single factor. As there seems to be a good deal of misunderstanding of the nature and origin of the disease it is advisable to give a brief resumé of the important points.

One misconception that exists in some places is that the disease has been introduced and spread by means of the imported breeds of poultry such as the R. I. R. which are being popularized by the Department of Agriculture. This is not correct. The disease is new not only to Ceylon but to science. The first record of the occurrence of this disease was a serious outbreak on a large poultry farm at Newcastle in England in 1926. The origin of the infection was never definitely proved but it was suspected to have come from America. The disease was dealt with very rigorously and did not spread and never became established in England. It is unknown there to-day.

In 1927 reports of a new disease of poultry came in from numerous and widely separated places, for example at Rhaniket in the north of India, the Phillipines, Java and Ceylon.

The source of infection was never definitely traced in any of these outbreaks. In India it spread with great rapidity from the north to the south and it is still a great source of loss to poultry keepers in India.

It is suspected that Ceylon was infected from India. At that time large numbers of live poultry were regularly imported from South India to Colombo and the disease first appeared in Colombo and round about. There is no definite proof of this but when investigations were made later it was shown that fowls actually affected with the disease were being brought from India to Ceylon. It was because of this that the import of live fowls from India and Asiatic Ports was prohibited in 1931. Following prohibition there was a considerable decrease in the number of outbreaks of the disease and there were periods of quiesence but the disease has never died out since it started in 1927, and recently it has shown evidence of increased activity.

The disease is essentially one which is spread by direct contact. Spread of infection by intermediate agents as for example crows and dogs carrying pieces of carcases of birds dead of the disease does occur but only over short distances. In towns and villages crows and dogs play an important part in disseminating the disease once it has been introduced but they are of little or no importance in carrying the disease over any considerable distance. That is very evident from the experience of our own Departmental farms. These farms are not situated in towns or villages and we have never had the disease at any time on any of our farms with one exception and that was the Tinnevelly Experiment Station where the fowl runs were within a stone's throw of a busy public road. The experience of large poultry farmers on estates have been similar, for example the brothers Van Geyzel and Mr. Schrader have probably the largest poultry farms in Ceylon and none of them has ever had this disease. It may be stated with confidence that in 99 per cent. of outbreaks the primary infection is introduced by fowls either actually sick with the disease or which have been in contact with sick birds.

Once introduced into a village or town, intermediate agents such as crows and dogs can and do play an important part in spreading infection.

To control or prevent spread by such intermediate agents is of course a very difficult task and so the most useful measures are those designed to prevent the primary introduction from outside areas.

Transport of fowls by railway is a frequent means of spreading infection over long distances in a very short time. A recent example will illustrate this. An outbreak occurred in Anuradhapura. This was soon followed by reports of outbreaks at Galle, Katugastota and Trincomalee.

In the case of Galle there was clear and definite proof that infection had been introduced by fowls brought from Anuradhapura by train and in the case of Trincomalee and Katugastota there is good reason to believe that the same applies.

It is therefore very important that early and stringent measures be taken to prevent fowls from an infected place being sent out by rail.

The disease was added to the list of diseases under the Contagious Diseases (Animals) Ordinance (Chapter 327) in 1931. This was done in order that regulations could be passed prohibiting import of fowls into Ceylon from countries where the disease was known to be widespread.

At first no attempt was made to deal with outbreaks in accordance with the regulations framed under that Ordinance. It was thought that the difficulties of enforcing the regulations would be very great. In some areas the attempt has been

made to deal with the disease in accordance with the regulations, and experience shows that such action can be very useful even when it is not possible to attain rigorous enforcement of all details of the regulations.

The attention of all Revenue Officers is therefore drawn to this disease because (1) it is a serious stumbling block to the development of a very promising village industry (2) it is causing a scarcity of eggs and table poultry and (3) there is reason to believe that utilization of the powers under the Contagious Diseases (Animals) Ordinance is likely to be very useful in checking spread.

The main points which should be borne in mind are—

(*a*) The disease causes a high mortality generally over 80 per cent.
(*b*) There are no carriers.
(*c*) Recovered birds have a strong and lasting immunity.
(*d*) The virus is delicate and readily destroyed outside the fowl's body by natural agencies such as sunlight.

For these reasons the disease is theoretically one which it should be possible to eradicate completely from an island such as Ceylon in the same way as it has been possible to eradicate Rinderpest.

(*e*) The sick fowl and the fowl which has been in contact with sick fowls are the normal means of introducing infection into a clean area.
(*f*) The railway and 'buses can act as rapid means of disseminating infection over long distances.
(*g*) Carelessness in disposing of carcases is very common. They are frequently thrown out on rubbish heaps, into ditches, dust bins, &c., instead of being burnt or buried deeply.
(*h*) The reprehensible practice of selling off all contact birds as soon as the disease appears in a poultry yard is one of the ways in which the disease is rapidly spread.
(*i*) The activities of hawkers must be stopped as soon as the disease occurs in any area.
(*j*) Up to the present no practicable curative or preventive treatment is known and attempts at treatment should not be encouraged.
(*k*) There is some suspicion that the regulations prohibiting import of live fowls may be evaded by small sailing craft from India and inquiry should be made as to whether this is in fact occurring. A feature of the disease has been the frequency with which it occurs at sea coast towns.

# DEPARTMENTAL NOTES

## HISTORY OF THE DEPARTMENT OF AGRICULTURE, CEYLON

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### III.—AGITATION FOR A SCIENTIFIC DEPARTMENT

#### Agriculture through the Centuries

#### (*a*) "Subsistence"

AGRICULTURE in Ceylon remained for centuries at the familiar "subsistence" level till the "economic" crop as an article of commerce came to stay with European rule. Rice was the staple diet. Contrary to earlier theories it is now believed that the Sinhalese who came with Wijaya (circa 550 B.C.) were not the first to cultivate paddy. Perhaps it became a regular "wet crop" for the first time under them with their inherited genius for irrigation, but earlier civilizations seem to have cultivated various types of paddy as they could in addition to other grains and millets. It must be conceded that pre-Sinhalese civilizations, of which there were substantial traces, cannot have subsisted solely on the *chena* and the chase.

Paddy and the *chena* crop still rule rural agriculture. The problem of the Department to-day is to ensure maximum yields in the former with improved methods of cultivation, and to mitigate the effects of the latter on soil and vegetation.

The *chena* is often represented as a very wasteful and shifting form of cultivation. But considering its antiquity its effects have not been disastrous (Legend speaks of the Lord of Katara-gama meeting his consort Valliamma, the daughter of a Veddah Chieftain, as she kept watch over her father's *chena* lands). The *chena* is also spoken of as a lazy man's occupation ; but we have authentic evidence from a Polonnaruwa inscription that a Sinhalese King—Nissanka Malla—waived or reduced the dues for *chena* lands on the basis that it required more industry than paddy cultivation ! The truth is that it was merely a supplemental food crop to eke out what the peasant's paddy land and garden plot gave him, and the idea of wastefulness came only with commercial timber. Felling the same jungle every 10 to 15

years seems no doubt a wasteful procedure these days, and one of the outstanding experiments of the Department to-day is a trial—the first in the history of Ceylon agriculture—to reduce this cycle by appropriate rotations with leguminous crops, and possibly organic manuring. At Kurundankulama—4 miles from Anuradhapura—a notable experiment is also being tried to test the economic feasibility of " dry farming ".

Above all there is the land problem which the Department has to face. As we have seen, " commercial " agriculture caused a vast aggregation of holdings in the wet zone, and except in the sparsely irrigated expanses of the dry zone available units for rural agriculture are mostly uneconomic. A peasant-farmer class as in India is difficult to foster, except perhaps in the frugal and industrious Tamil districts of the North. A rural gentry is also non-existent, in contrast to European countries, as wealthy landowners prefer to live in the towns.

### (*b*) Commercial

The Portugese and Dutch both introduced many useful plants, the former from the West Indies, the latter from the East. To their acclimatizations Ceylon owes among others the guava, pineapple, chillie, papaw, jambu, custard apple, murunga, manioc and dhall. The anonas and passion fruits were introduced very early from Tropical America. Citrus fruits came from India and Java, sapodilla from the West Indies. Under British rule the Peradeniya Gardens continued the process, and Ceylon obtained durian from Malaya in 1850, mountain papaw from Peru in 1880, tree tomato in 1884 and cherimoyer in 1882. Peaches, apples, plums, strawberries and pears were tried from time to time at Hakgala Gardens, and all except apples are being successfully grown at the higher elevations.

However, the commercial prosperity of the Island from the early 19th century onwards was founded successively (with some overlapping) on coffee, cinchona, tea, cocoa, coconuts and rubber. The Dutch and British both made much money from cinnamon, but substantial prosperity came with the rest.

*Coffee* saw a rush for planting in 1837, with great prosperity from 1856–70, reached its zenith in 1869, and began to collapse with the appearance of the leaf fungus disease *Hemeleia vastatrix*. Competition from Brazil, unaffected by the leaf disease, finally ousted it from commercial agriculture.

*Cinchona* was a short chapter bridging the gap between coffee and tea from 1877 to 1888. The annual output from 1884 to 1888 was about half the world production—a startling fact to realize in these days of imported quinine. It was first established at Hakgala Gardens in 1861, for which the site was really opened.

A superior type from the Netherlands Indies ultimately ousted cinchona.

*Cocoa* also helped to bridge the gap, introduced in 1819 and cultivated systematically after 1870. It can still be accounted a commercial crop next to tea, rubber and coconut, subject to heavy competition from African colonies.

*Tea* the richest single product today with an export trade of Rs. 200 million in some years, after slow beginnings in 1840, forged ahead from 1880 onwards.

*Coconut* grown as early as B.C. 161 according to the *Mahawansa* (The Ancient Sinhalese Chronicle) was cultivated on a commercial scale from 1840 onwards, and till recent years had earned for its stability the soubriquet of " Consols of the East ".

*Rubber* (*Hevea brasiliensis*) was the last of the major crops to establish itself, first planted at Heneratgoda Gardens in 1876 from seedlings raised at Kew, out of seed smuggled from the Amazon Valley by the intrepid Sir Henry Wickham.

*Tobacco*, *arecanuts*, *citronella*, *pepper*, *vanilla*, *nutmeg* and *cloves* are minor industries.

As we shall see presently, the misfortunes of European planters with coffee disease in particular, and the scares created with similar threats to tea and cocoa, put commercial plantations in the vanguard of a persistent agitation for a properly-equipped and adequately-staffed scientific Department of Agriculture.

### The State and Research

A Government Department presupposes State action, and it must be appreciated that individualist theories of the 19th century in Europe kept the State in the background, relegating it to the status of a mere policeman to preserve Law and Order. Broader conceptions of its status and functions arose with the Organic Theory of the State later in the century, and early in the 20th it came to be regarded as the " most representative organ of the community " and " the great architect which correlates ". Experience also showed that the State alone had the capacity to undertake expensive and protracted research.

It is therefore reasonable to assume that British colonies were permeated similarly with *laissez faire* ideas, and nothing wrong appeared in leaving individual industries to work their own destiny. The Tea Industry had for an appreciable time to pay scientists of the eminence of Green and Carruthers from private collections, and almost all his period of service Bamber worked for a retainer. The first up-surge of protest and agitation came from this industry, which urged that the largest single contributor to the revenue had a claim on Government funds for scientific assistance.

In the late 'nineties there was also persistent criticism in England that she was getting behind Germany in science and industry despite all her initial advantages. The "London Times" said :—

"There is in Germany an immense industrial demand for men scientifically trained to investigate the properties of matter. In this country there is hardly any demand at all. Her commercial domain will go on extending and ours proportionately shrinking, unless Englishmen become practical enough to look beyond their noses, and wise enough to believe in knowledge."

The *Ceylon Observer* echoed this sentiment with :—

"The lesson taught the nation in industrial and commercial matters, in which Great Britain is paying the penalty of a narrow conservatism which has enabled American and German goods to oust British goods even in British Colonies, ought to be laid to heart, and applied to matters agricultural, if there is to be progression, rather than stagnation and retrogression".

### Growing Agitation

The agitation in Ceylon, which grew in volume till Government was forced to appoint the Commission of 1899, may be detailed and analysed for convenience and clarity under three separate heads :—

(*a*) planting interests,
(*b*) "rural" patrons,
(*c*) Agricultural Education.

The *Ceylon Observer* was in the vanguard of all three under the able editorship of John Ferguson, who had, by founding the *Tropical Agriculturist* in 1881, created another fitting medium to carry on a controversy which his uncle A. M. Ferguson had started.

### (*a*) Planting Interests

In the years 1897 and 1898 The *Observer* returned to the charge, and like the *Times*, opened its columns to editorial and other comment which often became both violent and vitriolic.

Thus an *Observer* editorial of May 7, 1897 :—

"Ceylon, although ahead in much is still behind in a good deal as compared with its neighbours. So much of our prosperity depends on Agriculture, that one would naturally conclude the Government would see to it that every kind of scientific assistance was rendered to those who are engaged in the work, and when difficulties arose, or a blight of any kind threatened the prosperity of any of its branches, that there was a Department of Agriculture to which we might go for expert advice. But as we all know this is not so. Just at present there is considerable anxiety as to where the cocoa pest may land its planters and those dependent on the industry. It may be something else later on ; indeed there is much even now that ought to be studied in respect of our tea and coconuts, not to speak of minor, new and untried products. India has its Agricultural Department and special officials—so has Java, where indeed all the cadets for the Covenanted Civil Service have to acquire a special grounding in agricultural knowledge before they are allowed to take up revenue or administrative work . . . . Here we have not even an Entomologist in the Government service to verify a "poochee" —much less an allowance made to a competent Entomologist available on the spot—but have to depend on the gracious services of private observers who have taken to the study for pure love of it."

"When one thinks how much money is at stake in connection with the Agriculture of Ceylon, how even the very stability of the Government depends on its prosperity, it is passing strange that so little is done to guard its interests or guide its destinies. When an Entomologist was asked for by the Planters' Association, the request was refused, and it is only when the steed has been stolen that our authorities bestir themselves and endeavour to lock the door.

"A London merchant, who has intersts in cocoa in Ceylon, has been writing out regarding the Government Reports which the Republic of the United States issue from its Departments of Agriculture, for the advice and guidance of fruit growers there. These Reports are extremely practical . . . . It is an object lesson which carries conviction and the fruit-grower, if his garden or plantation be a failure, has himself to thank for the want of success. For he is not left as is the cocoa, tea, and coconut planter in Ceylon to puzzle out what ought to be done.

"In the Ceylon crusade against the cocoa pest men seem to be all at sixes and sevens. That it is a fungus is the belief of some, while others hold it is a beetle; and as for remedies, the white wash and tar brushes have been much in evidence, and after that too often comes alas! the saw and the furnace . . . . . If the men who are interested in it only knew what to do, there would be a determined effort to do it; but they fight their enemy in the dark, waste their strength in wild blows at nothing—and many are so sick of experiments that they are letting things take their course till the expert promised has arrived, studied and spoken. Had there been a Department of Agriculture to turn to or even an Entomologist to examine carefully, experiment and then advise, this weary waiting might have been avoided, and less treasure lost. Scientific advisers are the need of the day."

The administration of the day was trounced in no uncertain terms, and right through the trenchant editorials of these years we find bitter criticism of the policy of "expansion" in other directions, to the almost complete neglect of agricultural interests.

"It must be deemed a lasting disgrace to the Government of——that it should have refused the Planters' Association the aid of an Entomologist at the time a special appeal for one was made.

"Would it be considered dreadfully heretical to advise the reduction of our nine Government Agencies to four or five Collectorates, and the devotion of the salaries and allowances so saved to the establishment of an Agricultural Department and Scientifi (staff to deal specially with the enemies to which all our food, fruit or other commercial products are subject? . . . . a far more useful service than the devising of better means of collecting revenue or the watching over land applications, encroachments and sales. Since the abolition of the only semblance of land revenue assessment and collections in Ceylon, what have our nine Government Agents to do of any importance that would not be disposed of by two or three Collectors from Southern India? A thousand worries and trifles affecting Kachcheri routine do not and ought not to count in such a case."

On 25th May it wrote again :—

"It is somewhat ludicrous to note the progress made by tiny insignificant West Indian islands in calling in science to the aid of their agriculture and planters, as compared with the do-nothingness of the Ceylon Government. The Ceylon Civil authorities seem to content themselves with showing a budget worthy of the first of Crown Colonies, due mainly to a Customs tariff—which enlightened administrators ought to be ashamed of—and to a Railway income with which no single Civil Servant has anything to do . . . .

"The only practical step taken in all the years of prosperity has been the establishment of the Agricultural School—now threatened with abolition!

"One would think that, after the extinction of our coffee through the operation, first of, an insignificant fungus and afterwards of a scale insect in green-bug, one of the first steps taken by a Ceylon Executive could be the establishment of a Scientific Board of Experts to watch over the new staple tea—on which local prosperity so largely depends—as well as over our palm and other branches of agriculture. Not a bit of it. The salary—even temporarily—of an Entomologist was grudged and absolutely refused . . . .

"Everything in Ceylon, in fact, has been left for the planter agriculturist to find out for himself, save in so far as the Royal Botanic Gardens, the Director and his lieutenants could render aid. Anything like scientific experiments at the instance of the Government, for the benefit of planters or farmers, Europeans or native, has never entered into the local official mind."

On 29th May again it had something to say :—

"The subject of 'agricultural development' is one that may be regarded as a continuous permanent topic of discussion in Ceylon. We can never exhaust it, for there is always some fresh development of existing industry which demands attention."

The Editor then goes on to refer to a lecture recently delivered in Jamaica by Dr. Morris, C.M.G., of Kew, before the Governor

and a large body of the residents. Dr. Morris had covered a wide range of subjects including bananas, grapes, oranges, grape-fruit, pineapples, tree tomatoes, potatoes, ginger, tobacco and agricultural teaching.

"It may be hard to say what Ceylon could do as a rival with existing fruit-exporting countries were her resources properly tried and with the aid of refrigerating rooms in ocean mail-steamers."

Then in prophetic vein the Editor continues : —

"This lecture was followed by an animated discussion in which the Governor bore his full share ; and if it be true that Sir Henry Blake is ere long to secure the Governorship of Ceylon, a more than ordinary interest will attach to his views and to his personal experience of agricultural development."

It is a pleasant thought that Sir Henry Blake did come to Ceylon as Governor in 1908 and became the founder of the Agricultural Society in 1904, taking a keen interest in both estate and rural agriculture.

The reference to fruit-growing, however, makes melancholy reading today, 44 years later, when, with the first Fruit Development Committee Report just published, a Director late in the line of succession finds it still an incipient industry in Ceylon.

Later in 1897 the Government by way of concession arranged for the appointment of E. E. Green as honorary Entomologist, which he was apparently able to accept being also a practical planter with interests in estates.

But this only fanned the flame. Said a planter in the *Observer* of June 12th :—

"Why don't we have Honorary Colonial Secretaries, Honorary Governors, &c. ? Government will spend money on beautifying Nuwara Eliya or any place where it is pleasant to pass the hot season ; but spending money on a scientific department will not catch on long. If some of the money spent on the tomfoolery, Sir—indulged in, when he multiplied Government Agencies and so multiplied Provincial officers and cost of buildings to represent worthily the splendour of those new Provincial Chiefs, had been devoted to provide salaries of scientific men to report on our agriculture, &c. What a blessing to Ceylon that would have been ?

"Peg away, therefore, till we have two Scientific Investigators to watch over the Agriculture of the Colony, and have nothing to do with honorary appointments."

But there was no immediate sign of a permanent appointment, and on February 25, 1898, the *Observer* returned to the charge :—

"It is no new cry for us to take up that of the need of a Scientific Agricultural Department ; and that we are again referring to it, is for the object of bringing prominently before the Government what has been done elsewhere in the same time, and the happy results which have accrued therefrom. The failure of the sugar industry in the West Indies has been so widespread and so serious that after the report of a specially appointed Commission to inquire into the causes, the Imperial Government has decided to grant some relief . . . .

"It is to be presumed that in time British colonists and tropical planters will wake up to the need of having the best scientific advice available for all kinds of tropical agriculture.

"Our home authorities have the courage to run a railway through a sparsely-populated and a lean unhealthy land ; although when approached for specialists for such a thing as the cocoa disease, they fail at first to find one. A thoroughly equipped Scientific Department, ready for every kind of agricultural investigation would pay the country and the whole body of agriculturists a great deal better than broad-gauge lines to the North, &c."

The *Observer* was at it again on September 28, 1898.

"The old saw that 'experience teaches fools' has long ago been discredited; for it is only the wise who benefit in this way; a fool never! Still, like many another untrue statement the proverb lives on, to mislead the unwary. In Ceylon it would seem as if often the school of experience has closed its doors, and that the teachings of the past were to remain disregarded."

Quoting a planter who had written on the same theme, the editorial proceeds :—

"Our Government likes big schemes, evidently, a Railway to Jaffna for example, where such a scoop is taken out of the island's surplus in one dip, as would meet the outlay for a trained band of scientific agricultural experts for a generation to come. His Excellency may desire to hand down his name as an up-to-date railway man, and leave his mark in that dreary region of the North-Central Province."

Finally the article winds up with the familiar diatribe :—

"A scientific officer or two would not cost more than a very few of the Cadets who are dancing their heels about Kachcheries to very little practical result."

### (c) "Rural" Patrons

In the last century even among those who espoused the cause of rural agriculture there prevailed a feeling of diffidence at the very idea of weaning the peasant from his age-long methods of cultivation. Many seriously inquired whether he would ever care to be taught, and the surest way of raising a laugh those days at any agricultural meeting was to talk of improving the practice of agriculture in the villages.

Judged in the light of present-day experience it is clear that even the most honest and sincere of these "rural" patrons were misguided in their early efforts, and the less sincere of them were openly cynical, dallying with rural agriculture as a mere hobby and assuming the role of patron merely to patronize. We in our generation may be wiser, profiting from accumulated experience and benefiting from larger revenues, but it is surprising that a body of men—both Europeans and Ceylonese—who could agitate through decades, from behind rising incomes, for more and more Government assistance for plantation agriculture, should have believed that the helpless villager of their solicitude could raise himself into a gentleman-farmer by merely having his ears filled with "education" and chatter, but not his hands with the wherewithal to buy the eulogized implements and feed his family and himself while he tried them.

But that was a much earlier generation. True insight and reform came with the Agricultural Society of 1904, and the villager found a more understanding patron. In fairness to the older generation it must be said that they did have some organization, and an Agricultural Society was actually founded in 1843. But it seems to have lasted only two years, since J. W. Bennet writing the following year in his *Ceylon and its Capabilities* refers to it as already dead and replaced by a Horticultural Society.

The Agricultural Society of 1843 had a membership of over 150, with the Governor as Patron and the Colonial Secretary as

President. It promoted and encouraged agricultural shows at home and corresponded with agricultural bodies abroad. But it had no field organization like its eponymous successor of 1904, and the failure to establish itself, at least in the cause of rural agriculture, was apparently due to its activities being somewhat academic. Besides, neither this nor the branch Agri-Horticultural Societies that succeeded it seem to have been seriously meant to promote rural agriculture in the interests of the native peasant. They discussed cotton, tobacco and vanilla no doubt, but they also seriously canvassed the introduction of Chinese labour into Ceylon (proceedings of the Kandy Agri-Horticultural Society, March 6, 1858).

It was then apparently all a matter of the village plough wearing a Top Hat.

### Shows and Exhibitions

On March 29, 1897, after a recent Agri-Horticultural Show in Nuwara Eliya the *Times of Ceylon* made the following introspective comment :—

" But if we ask ourselves what good has resulted from the exhibition just over, or from similar exhibitions in the past, as far as the natives of this country are concerned, we must say it has been almost *nil*. This may be a pessimistic view to take of the matter, but it is nevertheless a true one.

" Natives are persuaded to take part in these Shows, and to exhibit produce of different kinds, according as they are worked up by the various Government officials who have to do with such exhibitions, and the extent of native participation is generally gauged by the energy, and often the popularity, of their European superiors. The attendance of natives is also influenced by officialdom, and where, as at the Nuwara Eliya Show, His Excellency the Governor takes a keen personal interest in the proceedings, it will be found that the interest of chiefs and leading natives generally is proportionately visible.

" The Governor referred to the influence of Agricultural Shows on native agriculture in a manner which showed that the subject is new to him, and, after a longer sojourn in the Island, he will probably be led to modify his views about improving native agriculture by means of semi-European Shows or by any other occidental means.

" The history of the question in Ceylon proves the futility of this ; and the miserable failure of the Agricultural School in Colombo, which has been attracting attention of late, is only one more proof of the justice of our contention. His Excellency was good enough to suggest matters that the local press should write about. Among these he particularized agriculture in Ceylon, and he invoked the aid of the local newspapers in its regeneration. Speaking for ourselves we may say that, if by writing about the subject in any shape we could bring about such reforms in native agriculture as would increase the productiveness of the soil of Ceylon and imbue the native agriculturist with energy, perseverance, and intelligence, we would devote a large portion of our paper every day to effect such a beneficent result.

" But it is hopeless to expect that, where practical example, practical help, and practical supervision have failed to induce the native to change his ways writing articles in newspapers will have any better effect.

" The subject of native agriculture has cropped up periodically in the press, in official reports, in Legislative Council speeches, and in prize distribution addresses, with unvarying regularity ; and official interest in the matter, which goes back even beyond Mr. Green's introduction of Swedish ploughs to supersede the primitive village article, some time ago culminated in the establishment of the Agricultural School, which we believe is now admitted even by sanguine officialdom to have entirely failed in the object for which it was started.

" Lest it seem that we take a prejudiced and too gloomy view of the question, we may point out that there have been some officials with courage enough to tell the truth as we have told it ; while leading and intelligent natives have repeated the same warnings against trying to occidentalize the oriental villager. Mr. Ponnambalam Coomaraswamy, for instance, in Council ridiculed the Agricultural College, its teaching and its instructors, and, though he is not a Sinhalese, he is, we believe, a large landowner, and he may be assumed to know something about native habits and prejudices.

"The same thing has been found out in India, where agriculture is more successfully carried out by a more industrious and persevering people, and, if the Bengalees and the Tamils, who, as agriculturists, are worth twice the same number of Sinhalese, will not change their methods of tilling the soil, it is a hopeless task, we fear, to expect the Sinhalese population of this Island to do so."

A correspondent gave expression to similar views when he commented :—

"The fact that Agri-Horticultural Shows have hitherto been held in centres chiefly affected by the European community would seem to point to the probability that the social, rather than the practical aspects of the collection of interesting exhibits have weighed most with public servants."

Today we can happily say that the annual Agri-Horticultural Exhibition at Nuwara Eliya, which is a legacy of those days and is organized by a Society, happens to be the only exhibition of which the social attraction proves to be as strong as the agricultural. But it is just as well perhaps that this Annual Show should continue with undiminished vigour because it provides the only opportunity for many a "deruralized" town elite to see a pumpkin or a brinjal !

Half a century later we can scarce suppress a smile at the unbounded optimism of those enthusiasts who seriously and sincerely believed that island-wide shows, exhibitions and lectures could alone revolutionize the village mind and village agriculture into new ways of cultivation. Today, the Department of Agriculture, with its numerous stations, farms and demonstration plots, and Divisional and Research Staff, increasingly realizes that the root cause of village decadence is more physical than psychological. With our ideas today of planned research, scientific management, co-operative loans, and above all, guaranteed markets and prices, it is becoming apparent that peasant agriculture, once relieved of the enormous initial handicaps that are beyond the peasant's capacity to surmount unaided, admits as much of economic management as does planting agriculture itself.

Under the present Ministry of Agriculture, with co-ordination of departments in a manner unknown before, an era of mechanized farming is just beginning, with tractors to fell unyielding forest, aided by the paraphernalia of angle-dozers, &c., to stump and uproot. The solution that eluded European officials like Mr. H. W. Green, with his honest Swedish plough, and his equally well-meaning successors is now in the grasp of the Department of Agriculture, *viz.*, that implemental cultivation is ineffective without thorough scouring of the soil for obstructive roots and stumps.

All the same it is fair to examine the ideas and opinions of those days in a background not merely of current politics but also of current political theory. As we have mentioned earlier, self-help was still an accepted creed in England (the plantations

suffered too) and the State had hardly begun to ameliorate social conditions with legislation for Housing, Health and Old Age Pensions. So, agriculture could hardly have expected a benevolent paternalism. The limited vision of those days, moreover, despite the undoubted sincerity in motive, is shown to best effect when we analyse the views held on, and the results expected at the time of, agricultural education.

## AGRICULTURAL EDUCATION

### (*a*) Clues and Cues

The history of agricultural education in Ceylon is one of extraordinary appeal, and its course is of particular interest to the Department of Agriculture. The varying up-surges of convergent and divergent ideals and the vicissitudes that attended almost every experiment tried are a mere mirror and reflection of the conflicting theories of which we have not seen the last up to this day, some six decades after the opening of that first school in Colombo in 1884 by H. W. Green, C.C.S., Director of Public Instruction.

The very institutions changed hands numerous times much like Vimy Ridge and Siddi Rezegh of recent military memory. And in many respects it does not appear quite certain yet which Department should have the bigger " pull "—Agriculture or Education.

First, the then Department of Public Instruction opened the Colombo School in 1884, till the agitation that it served no useful purpose brought it to a close in 1901.

Soon after, in 1902, a School Gardens Organization was constituted by the same Department, with a Government Stock Garden serving as feeder, to teach agriculture in a more practical form to the Schools. The increasing dependence of this organization on the Department of the Royal Botanic Gardens for scientific advice and planting material (all of which could not be supplied by the Stock Garden) led to its transfer in 1906. Then again in 1931 the Director of Agriculture, yielded it back to the Department of Education. Meanwhile however, the Department of Agriculture had resuscitated the idea of a School, and one was opened at Peradeniya in 1916, known first as the School of Tropical Agriculture, later in 1922 as the Farm School, Peradeniya, and finally in 1940 as the School of Agriculture, which under University auspices may prove to be the beginnings of a Faculty of Agriculture.

The present arrangement appears broadly to be to vest elementary education in the Department of Education and advanced training for an agricultural career—whether official, personal, or arm-chair—in the Department of Agriculture.

For the first time in the history of the pivotal field staff—the office of Agricultural Instructor goes back to 1886—officers are directly recruited for a 2-years' training at the School before appointment. This scheme was introduced in May, 1937. Although it is incontestable that there have been many notable successes both among those recruited before 1916, with some short training at the Royal Botanic Gardens and the Experiment Station, Peradeniya, and those who joined afterwards with the School Certificate, this special recruitment and training with stringent provision for "axeing" of misfits has tended to produce a very successful and effective type of officer, answering to the requirements, whether of the rural agriculturist in the field, or of the Research Officer in the field and laboratory.

The close connection between agricultural education and the agitation for a Commission is explained by the ingrained belief that agricultural education was the "open sesame" to a complete revolution in the methods of rural agriculture. The conservatism of centuries, some of them said, could be broken only by enlightened teaching. Towards the end of the century many expressed open dissatisfaction with the direction of the Colombo School of Agriculture, and it was the appointment of a Committee to investigate into its workings that crystallized agitation for a wider inquiry by a Commission into the necessity for a Department of Agriculture.

### The Colombo School of Agriculture 1884-1901

H. W. Green, C.C.S., in his Administration Report for 1884, as Director of Public Instruction, records :—

"The School was opened on the 14th of January, 1884, with 28 boarders and a few day-students, whom I personally selected from some 80 applicants for admission. The greater part of them were the sons of men of property, as I desired that this class of students should put in practice upon their own lands hereafter the lessons in agriculture which they might learn while at this school. A few, however, were admitted, who had little or no property, with the idea that they might prove useful as Superintendents of estates in planting districts where European Superintendents suffer in health. I also trust that some of these poorer students will be useful to me as teachers in Provincial Agricultural Schools, should the movement in favour of agricultural education prosper.

"After a few preliminary difficulties and frictions, 22 students settled down with a will to their new work, and I am well pleased with them.

"The first year's work was, in accordance with the scheme, all theoretical, the practical work commencing with the year 1885. And I may say in anticipation of my report for 1885 that the students have taken most kindly to the rough manual work of ploughing, and so forth. I mention this especially, because it was thought by many that boys of their position in life would consider ploughing as beneath their dignity. An 'Instructor of Agriculture' was arranged for, and was to have arrived at the end of the year, but unfortunately there has been unforeseen difficulty in securing a proper person.

"The practical work has been temporarily placed under Mr. A. Jayawardena, a Sinhalese gentleman who was himself educated at the Saidapet College in the Madras Presidency."

Before we follow its tenuous course to extinction in 1901 it is interesting to examine whether the last word has yet been said, anywhere in the world, on agricultural education ; and whether in Ceylon here the ideal has yet been attained of running the slogan "Back to the Land" into earth in either sense of the term.

When John Ferguson appealed in the *Tropical Agriculturist* of 1882 for some agricultural education, accompanied with practical work, his aim he said was—

" to divert the ever-abounding and continually increasing thirst for the youth of Ceylon to enter the legal or medical professions, or to rest content with a clerkship. If only such a diversion could be effected, what a different race we should have in time to come ! How much they themselves would be benefited and the island in general ! "

Prophetically untrue !

A journalist of a much later day (*The Ceylon Daily News* of December 3, 1941) reviewing an experiment (save the mark !) in Wales, utters this familiar agricultural lament :—

" The most common complaint is that there is still too little formal technical instruction in the schools. As in other countries the difficulty is to steer a middle course between the academic and the purely vocational. Agriculture is essentially an applied science, not in itself of much educative value ; while on the other hand, an attempt to give it a sociological rather than a vocational orientation, in order to widen its appeal, often results in making it completely unreal to the pupil. There is need of close contact between the schools and the farms, which is often difficult to attain in a country where even in the rural districts the factory and the workshop are both more real and more attractive than the land. This is less acute in a land like Ceylon which is still predominantly agricultural, and where there is more " future " in agriculture than in any alternative occupation. Here our main problem must always be to see that the land is not left to the merely rustic. . If the ' bold peasantry ' is to be, as Western and oriental tradition have agreed it should be, ' its country's pride ', it must be educated, not only in the sense of being schooled in academic subjects, but also and especially in the sense of being educated in the use of its hands and agricultural implements."

### Its Aims

The Colombo School was a monument to that good type of Government Agent, who made an effort to do his best for agriculture in the absence of a special department. This was the first official attempt at organization, and Mr. H. W. Green, the founder, brought to bear his experiences of rural agriculture on the institution he founded as Director of Public Instruction with a three-fold object, viz. :—

(i.) to create a class of trained landed proprietors,
(ii.) to equip young men for posts of Estate Superintendent,
(iii.) to train teachers to give instruction on agriculture in village schools.

Mr. Green was earnest and sincere, enthusiastic and hopeful. But his project carried with it the seeds of failure. Mr. John Ferguson pithily summarized the causes in these words, writing in 1909 :—

" There were serious flaws in Mr. Green's scheme. His selection of a site (guided no doubt by consideration of economy) was most unfortunate ; his curriculum of work was not sufficiently practical, and included much that was calculated to attract scholars ; he did not provide for the institution being utilized as a training ground for the large number of petty village officers who in a great degree control the destinies of the rural population. It was hardly to be expected that the sons of the conservative cultivators would have looked to an institution in which they had no faith. The same difficulty as regards attendance was for a long time experienced in England, where agricultural education was decried by the practical farmers of the day as a fad ; and this difficulty was a more formidable obstacle in an Eastern country. "

The present Department has happily eliminated all the shortcomings referred to in the above epitaph. Stations are

scattered throughout the various climatic zones ; practical farm schools in different districts combine the necessary rural bias with a vivid recognition of practicalities ; classes for minor headmen were actually held at the Peradeniya School in 1917, 1919 and 1921 till discontinued as a retrenchment measure, but their superiors, *viz.*, Divisional Revenue Officers are given a six weeks' intensive training instead ; classes for vernacular teachers are held ; above all, sons of wealthy landowners who formerly went to England to become harmless barristers at great cost now turn increasingly to agriculture as a vocation, and, studying with a seriousness of purpose, regard visits to paternal estates not so much picnic parties as serious business undertakings.

If there is one impediment still it is the presence of the occasional careerist in the Learner Class, but it is fair to add that the initial salary of Rs. 56 a month for an Agricultural Instructor compares very poorly with the Rs. 250 that his compeer of similar age is promised as a Divisional Revenue Officer.

### Its Critics

Mr. John Ferguson's succinct estimate appears mild compared with that of the bitter critics who talked this School to its doom in 1901. All emphasized its failures, few recognized its achievements, and, virtually on trial before the Commission of 1899, it was unceremonously closed on March 29, 1901.

In his evidence before the Commission, Dr. J. C. Willis, Director of the Royal Botanic Gardens, made the following comment, which was typical of the general feeling :—

" The present School is, as we have seen, in the Department of Public Instruction, and it would seem better to transfer it to the Agricultural Department. It does not seem so far to have been a success. It is not easy to decide the actual causes of this. Want of sympathy with its objects and lack of knowledge of agricultural subjects on the part of those in authority may have had something to do with it, but I think the chief cause has been the failure to attract the class of students for whom it was originally intended, the sons of wealthy native land-owners.

" A second great cause, in my opinion, has been the character of the teaching syllabus ; there has been too much of general subjects and too much indoor teaching. The finished product of the school course is rather the young man of whom we have too many already, who would rather work with his head than his hands, and ' handle the pen in preference to the hoe.' In an agricultural school the students should work in the field with their own hands for at least half of their time.

" The school at present stands in Colombo on poor soil, and in a climate and soil which forms but a poor representation of those prevailing in most of the Island . . . .

### Its Apologist—Mr. Christopher Drieberg

But it had a notable apologist, Mr. Christopher Drieberg, Superintendent of the School from 1889 till its closure.

The early history of agricultural education and development (particularly rural) in Ceylon is incomplete by a long way without mention of the notable contribution made by Mr. Christopher Drieberg.

Born in 1862, he proceeded to Europe to study agriculture at Edinburgh University and returning in 1889 with the B.A. degree was appointed Superintendent of the Colombo School, of which till then Mr. Green was the nominal head as Principal.

Guiding its destinies till 1901, when despite his vigorous protests and proposals for reform the School was closed, he found solace in the substitute of his recommendation under the same Department, *viz.*, the School Gardens. On its transfer to the Department of the Royal Botanic Gardens in 1906, Mr. Drieberg continued as Superintendent and, becoming also Secretary of the Ceylon Agricultural Society in 1907, when "the novelty of it had worn off", he constituted himself an excellent *liaison* officer between the two parallel branches of Agriculture. He was the real founder of the School of Tropical Agriculture at Peradeniya in 1916.

In the time of Dr. Willis he helped to organize many Co-operative Credit Societies with the assistance or Mr. (now Mudaliyar) N. Wickremaratne and had helped to swell the number of school gardens to 400 at the time of his retirement. His designation was changed to Superintendent of Low-Country Products and School Gardens Division in July, 1913.

At a great farewell demonstration on his retirement from the Public Service in 1919, Mr. Petch the Acting Director of Agriculture said :—

"Agricultural instructors, agricultural shows, demonstration plots and farms are incidents in Mr. Drieberg's useful career. His work has earned the well-merited approbation of successive Governors. We may recollect Sir Henry McCallum's saying—
'Well may we have a Drieberg in every Province'."

Even after his retirement Mr. Drieberg's interest in agriculture remained unabated, and he was an active member on the Board of Agriculture of 1921. For a brief period he edited the *Ceylon Morning Leader*. He died in December, 1935, aged 73.

### His Apologia and Scheme for Reform

Mr. Drieberg analysed the work of the School under 3 heads (*Tropical Agriculturist*, 1899)—

(1) What it had done so far,
(2) What was expected of it,
(3) Why it was apparently a failure.

*What it had done so far.*—He "made bold to say" that it had done more good to the native population than either the Royal Botanic Gardens or the Colombo Museum which cost very much more. The School was at any rate a purely scientific and technical one, teaching agriculture with its allied sciences such as botany, chemistry and veterinary science ; and a product of the school, if he kept his eyes open, was bound to influence people with whom he moved. It at least succeeded in teaching educated youths the dignity of labour.

*What was expected of it.*—The great misfortune of this School, he pleaded, was that its friends and foes alike judged it by a severely high standard, *viz.*, what was *expected* of it.

Many personal friends among " leading native agriculturists " had told him they had expected the School to carry out experiments on the various products on a small scale at the school itself and on a large scale outside " with a view to showing how economic products could be cultivated on a commercial scale ".

But this, (and we should agree), was too much to expect of a School allowed only Rs. 6,000 a year !

Many expected the School to produce a rural gentry ; and, when this grand class failed to materialize they blamed it on the School !

Then again Mr. Green, the founder, himself had hoped for a revolutionary change in rural methods. He expected the Swedish plough to work miracles, but it failed :—

" The iron plough which Mr. Green tried to introduce was undoubtedly a failure, and some people are under the impression that this was all that the School tried to do ; *and when the plough failed the School was also put down as a failure.*"

*Why it apparently falied.*—When Mr. Green started the School he was anxious to have it as an integral part of the old Normal School, the only training Institution for Government teachers, and he succeeded in placing it in charge of the Principal and Science Master who was a European. The Vernacular Normal Students who were trained to be village teachers were taught botany, chemistry and agriculture in addition to the ordinary school subjects. Mr. Green's idea was to give them a training in practical agriculture also, to enable them to teach agriculture to the villagers through the schoolboys.

But in his absence on furlough Government decided to abolish the Normal School and open village training schools instead. A large saving was thus effected, but the Agricultural School now stood alone, much to Mr. Green's annoyance. Mr. Green, however, was equal to the occasion and sent out a number of passed students as teachers in the village schools. These were entrusted with more ambitious tasks, and designated Agricultural Instructors.

As we shall see presently, their handicaps weighed heavily on them, and when these Instructors failed in their mission the school came to be further discredited.

Then again a promise had been held out by Government to set a premium on the certificate of the school when making appointments to Chief Headmen's posts. But other influences had stood in the way, and an excellent medium for promoting agriculture in the villages was thus unavailed of.

In a pathetic attempt to save the school Mr. Drieberg urged various reforms—among them distribution of improved implements through trained instructors ; distribution of seeds and plants with the co-operation of the Revenue Officers ; circulation of pamphlets, bulletins and leaflets ; students to be taken on tour ; the Superintendent of the School to itinerate ; agricultural shows at different centres ; curriculum for vernacular students (to be nominated by Revenue Officers) drawn from the native headman class ; practical veterinary training ; and finally an independent status for the School with severance from the Training School, Practical School and Forestry School, with all which it formed one unit in a complex Institute.

The School was not saved, but all these proposals, without exception have formed an essential feature of development in the Department, or of the new School that came to Peradeniya.

### Retrospect

On the balance of evidence the critics and detractors of the School must be held to have been unfair and unjust. It achieved something, and two prominent Ceylonese agriculturists, the Honourable Mr. W. A. de Silva and the late Gate-Mudaliyar A. E. Rajapakse are monuments to its memory (to mention only the two most notable). The Agricultural Instructors it sent out did substantial work in the villages despite considerable handicaps, and the Agricultural Primer written by Mr. Green himself was taught in all Government Schools : at least people were made agricultural-minded. The Government Dairy, Colombo, founded in 1893 at Mr. Drieberg's instance, emphasized quite early the importance of livestock in a scheme of agricultural education, and soon after the appointment of a Colonial Veterinary Surgeon to assist in it and advise Government on veterinary matters a separate Veterinary Department came into existence about 1900. The first Stock Inspectors of the Veterinary Department had their training at the school. When the Botanic Gardens became the oracle for estate agriculture, the Colombo School even in an inferior way did the same for rural, and documents show that Government Agents genuinely interested in agriculture, like Mr. W. E. Davidson, were keen to have experiments conducted, and planting material supplied, by the school. Viticulture was taken seriously and an Italian named Zanetti was enlisted for some time to advise. Above all, what it did helped to emphasize what it allegedly did not, and the opening of the Experiment Station at Gannoruwa in 1902 near Peradeniya Gardens was a direct sequel to the analysis of its working before the Commission of 1899.

It was a great experiment and the experiment was worth trying, even if the only lesson it taught to future administrators

was the importance of a field agricultural staff. The Agricultural Instructor to-day, far more thoroughly trained and equipped, is the pivot of our rural development work, serving directly under Divisional Agricultural Officers.

### Agricultural Instructors

It will surprise many to know that the office of Agricultural Instructor goes back to 1886, that is, the year when the first batch passed out.

Passed students were sent out from the School on a salary of Rs. 30 to 40 a month to work under the patronage, rather than control, of the Kachcheries. Directed expressly to show improved methods of paddy cultivation to the villagers, an Agricultural Instructor had also to teach the Agricultural Primer in Schools, establish model gardens with the help if possible of school boys, choosing his own site, and what was more, to advance the cost of experiments till he could recoup himself with the sale of produce ! He had to find his own board and lodging, and the more elaborate his model garden the more he had to be out of pocket. Naturally the temptation was great " to keep an inexpensive show of a few plots stocked with easily grown vegetables ".

So much for our first experiment stations and demonstration plots with their highly speculative element !

If these Agricultural Instructors were a failure, the system rather than the men was to blame. There was sad lack of continuity. Their number at any time seldom exceeded 4 or 5, appointments generally depending on the request of a particular Government Agent. When this Government Agent was transferred the Agricultural Instructor was " left adrift as it were without a patron ". They worked under the immediate shadow of native chiefs " who had received no training in agriculture themselves and were as ignorant as the ordinary villager ". Facilities were very few, and the arrangement for creating model gardens justifies Mr. Drieberg's charge that they were " rather expected like the Hebrews of old to make bricks without straw. They had no money, no seed paddy, no implements given them ".

The prejudice against these poor men was as unfair and short-sighted as against the School itself. Mr. F. R. Ellis, C.C.S., dubbed them once as—

> " a happy band of youths who for a series of years received a good salary for cultivating Crown land with cattle supplied by Government and appropriated the produce for their own use."

Unkind words these for men " speculating " on Rs. 30 a month ! Many did honest work and the results of important experiments are still on record. But Mr. Ellis seems to have

been a cynical old man, for, shortly after we find him telling the Commission his estimate of the Botanic Gardens :—

"I believe that it is pretty generally admitted that the Department presided over by Mr. Willis has been little more than a scientific toy."

Today the Department of Agriculture spends nearly one lakh on Agricultural Schools, 5½ lakhs on experiment stations and demonstration plots, and 1¼ on providing planting material. We would view with horror and astonishment any proposal today to close all our schools and stations (and perhaps the Department itself!) on the ground that the Burmese harrow had made no progress yet, or that paddy still gave an average of only 25 bushels per acre!

The Colombo School was closed because, with its Rs 6,000 a year to educate 25 students, pay the staff, and conduct various experiments, it failed to revolutionize village agriculture!

The Agricultural Instructors had been discontinued in 1896.

Wiser in our generation, with experience of colonization schemes, &c, we are more charitable to the villager and to ourselves. We think in terms not of lethargy or stupidity so much as sheer incapacity in the absence of the necessary resources.

### The Appointment of the 1899 Commission

In 1896 a promise was made in the Legislative Council to appoint a Committee to inquire into the working of the School of Agriculture. In 1898 it was revealed that the Committee had not met, chiefly because the Colonial Secretary who was Chairman had left on furlough soon afterwards. Members then inquired whether "the scope of the Agricultural School could not be very largely extended in the direction of an Agricultural Department".

Mr Abdul Rahiman called it "more a Government pet than an Agricultural teacher", and urged that "by keeping on the Agricultural School and the Botanic Gardens separately a larger staff was required; it was a burden to the Government and unprofitable".

Sir Noel Walker, Colonial Secretary, said he had found on his return "every man's hand against the institution" although he considered that Rs 6,000 a year was not an exorbitant sum to spend on such an institution. However he agreed that—

"the question of an Agricultural Department for the Colony was a much larger one than an Agricultural School. He thought it was a good and proper thing in a colony such as theirs, on account of its being an Agricultural colony."

In the same debate the planting member urged that if the Committee was to meet at all to inquire into the working of the school the scope of the inquiry might be extended to examine the feasibility of an Agricultural Department to include a

cryptogamist, an agricultural chemist, and entomologist. He reminded Government that hitherto they had not succeeded in obtaining permanent appointments of such officers to the Department of Royal Botanic Gardens. Referring to Messrs. Green, Carruthers and Bamber, who were till then working independently or on retainers, the Honourable Mr. Mitchell said what seemed to him a requirement now was that "*all the scientists instead of acting independently should be brought together and combined in one Department of Agriculture under one directing head*".

H. E. Sir West Ridgeway, then intervening, announced his intention to appoint a Commission instead of a Committee to report on the larger question of a Department of Agriculture.

# SELECTED ARTICLES,

## COMPOSTING

### THE SAFE CONVERSION OF VILLAGE REFUSE AND NIGHTSOIL INTO A VALUABLE MANURE

THE Chinese from time immemorial have used human excrement as an important and never failing source of manure in their agricultural pursuits.

Indeed one cannot help being struck, almost everywhere, in Malaya by the success and hardihood of the so-called Chinese squatter in rearing vegetables. He succeeds in cultivating luscious crops on almost any kind of land, however wretched or inhospitable the conditions may appear to be.

The faculty of the Chinese market gardener in making infertile soil fertile, and in maintaining that fertility, is largely due to his clever use of freshly fermented nightsoil and urine.

Though vegetables thrive, the practice of putting human wastes directly on the soil is dangerous to health. The heavy toll of sickness and death from various bowel diseases in China is well known.

The Chinese living on the land in China, are an easy prey to a swarm of filthy parasites, and yet, in spite of this grave handicap, no one can deny the virility of the race and their ability to maintain themselves under conditions which would be fatal to those less inured to such devastating infections.

Health Officers in this country, and elsewhere, have been brought up, quite rightly, to regard the safe disposal of human excrement as an essential requisite for safeguarding public health. We could justify our action in preventing the use of nightsoil in agriculture, because of the serious risks to health which its use involved.

Health Officers and Sanitary Inspectors have been very active in stopping the supplies of manure so eagerly desired by the Chinese cultivator.

We have sought the co-operation of all educated men and women to insist upon the use of properly constructed latrines by everyone and we have been inclined to regard the installation of a water-carriage system as one of the final aims of civilization.

Though there has been little drama or reward for the Sanitarian in struggling against "the filth diseases" one has, at least, the satisfaction of knowing that, as a result of these latrine campaigns, a large number of persons have been saved from a miserable and untimely death and the constant drain on the vitality of our people from worm infection is lessening in this country.

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* Read at the Annual Meeting of the Malaya Branch, British Medical Association, Kuala Lumpur, March 23, 1940, by Dr. J. W. Scharff, M.D., D.P.H., Chief Health Officer, Singapore.

What I shall have to say later about "composting" should not be taken as a recommendation to relax those sanitary standards, which are slowly but surely being built up, with such good effect, throughout Malaya.

## PROGRESS IN RURAL SANITATION

In 1925 the International Health Division of the Rockefeller Foundation, in association with the Government of the Straits Settlements, undertook a "Rural Sanitation Campaign" lasting three years. At the conclusion of this campaign, the health authorities concerned had visited every part of the territories of Singapore, Malacca and Penang. They investigated the incidence of worm infections throughout these areas and undertook the treatment of many thousand persons found to be infected. During this time they organized the construction of sanitary latrines in every village and Government School throughout the land. Doctors Russell and Yaeger, who were the local representatives of the Rockefeller Foundation, also introduced the bore-hole latrine. This has since proved a valuable instrument for securing improvement in rural sanitation. Its value is so much the greater, because it removes all temptation of the illicit use of the contents of the latrine.

At the conclusion of the Rural Sanitation Campaign, I happened to be stationed in Penang and it fell to me to follow up the work there to its logical conclusion. In the administration of Rural Sanitation, it was sometimes necessary to institute proceedings against cultivators who continued to use their own, and other people's faeces in their gardens. Magistrates were not averse to inflicting heavy fines upon persons proved guilty of using human ordure as manure. The knowledge that there would be a heavy penalty, coupled with the gradual elimination of supplies, sufficed to stop the practice in two country places in Penang. This would have had a disastrous effect on local agriculture had it not been for the fact that the gardeners lived mostly near the seashore, and the alternative of fish manure was available in plenty (though at some extra expense) to make up for this loss. The Chinese are adaptable and thanks to the efforts of the Agricultural Department they were amenable to persuasion. It then became the established practice, wherever possible, to use the sea for dumping refuse, in the hope that fish might thereby thrive and fatten. Surplus fish, not required for human food, would thus in turn provide a safe source of nourishment for the soil. This plan of using fish manure sufficed, for a time, to ease my feeling that there must be something wrong in deliberately throwing away a substance which by proper manipulation might safely serve to enrich the land.

It had long been deemed beyond the wit of man to prevent this wastage. The priceless loss of this valuable material has been dramatically likened by Victor Hugo, the novelist, to a stream of gold flowing to waste along a sewer.

In the Tropics, the dangers of using crude sewage direct upon the land, are far more intense and deadly than is the case in a temperate climate where the risk of worm infection is relatively slight.

An editorial in the Indian Medical Gazette of February, 1934, drew attention to the fact that a method had been found in India to convert village refuse and nightsoil directly into humus. The composting method described in articles

by Mielazis, Jackson and Wad, was the Indore system. It was claimed that this method was simple, safe, economical and free from nuisance and that even fly-breeding was abolished.

Such a simple solution for a difficult problem in rural sanitation, seemed too good to be true. It seemed to me to be beyond the realms of reasonable expectation that this new method of composting could readily be adapted to fit the special conditions of Malayan climate and environment. I know now that I was wrong.

At the London School of Hygiene in the Summer of 1937, I had the good fortune to listen to an eloquent talk by Sir Albert Howard on the subject of composting. This information helped to convert me to the view that the Indian methods of composting were scientifically sound and that they should receive an extended trial in Malaya.

On my return to Singapore, in the Autumn of 1937, experiments in the composting of village refuse and nightsoil were begun. These experiments have now gone forward sufficiently to convince me that in composting we possess a means of stimulating agriculture and perhaps even of making the people of Malaya self-supporting in vegetable food.

In bringing these investigations to the notice of this Association I wish, in particular, to invite discussion upon the safeguards which may be needed to ensure that the work of composting is so carried out in Malaya as to cause no danger to public health.

## THE DEVELOPMENT OF COMPOSTING

Prior to the introduction of composting, by Sir Albert Howard and his co-workers in India in the year 1931, there had been many attempts to render human excrement, or its products, safe and fit for agriculture. All of these, so far as my experience goes, have failed in Malaya, because of the extreme resistance of intestinal worm eggs and amoebic cysts ; in only one of these attempts has there been a certain measure of success. Since 1932, the sludge from the Municipal Sewage Works in Singapore has been subjected to the heat of 140°F for about half an hour. This heating has been proved by Dr. Gilmour, the Municipal Bacteriologist, to be sufficient to destroy all pathogenic organisms, which may be present in the sludge, including the eggs of intestinal worms. The source of the heat is derived from the gas evolved in the Imhoff tanks and the process is therefore comparatively inexpensive.

The heated sludge, though no longer dangerous, is, however, of poor manurial value, since it is lacking in adequate amounts in nitrogen and potash.

Sludge in Singapore is given away free of charge for those who choose to pay for cartage.

This serves to emphasize the difference in value between the sludge of septic tanks and the crude nightsoil, for which the Chinese gardener is always ready to pay a handsome price.

It also serves to bring into view the great potential value of compost in which every element needed by plants is properly preserved.

Composting as originally propounded by Howard and Wad is a process whereby the waste products of agriculture are converted into humus. In principle it corresponds to the natural process which goes on in the jungle,

whereby the residues of plant and animal life are converted into humus, through the agency of fungi and bacteria. Nature's method of dealing with forest wastes, is to convert them into an essential manure for trees, by means of continuous oxidation. The revolution of recent years in the technique of rubber cultivation, by the " forestry method ", has been due to modern understanding of this principle.

The Indore composting process, which is based upon the same principle, was first devised for the manufacture of humus from waste products of agriculture. It was later adapted, as I have already said, to serve as a simple solution for the sanitary disposal of the nightsoil and rubbish carted from towns and villages in India. Further modification of this process resulted in the creation of the Culcutta system of composting, in which the compost is made in brick-lined pits, instead of in mounds or trenches.

In following up this work in Malaya one has to guard against the penalty of allowing enthusiasm or haste to outstrip good sense. There is a painful feeling that one might endanger health by listening too freely to the clamour for manure ; added to this there is a natural disinclination to proclaim one's interest in articles so unsavoury as nightsoil and rubbish. Experience shows that these objections can be overcome and I am now satisfied that, with reasonable care, both the Indore process and the Culcutta system, with very slight and easy modifications, as briefly summarized at the conclusion of this article, can be safely used in Malaya.

I am prepared to prophesy that composting of refuse in our village kampongs and estates will cause a revolution in the sanitary organization of our rural areas no less dramatic and no less beneficial than has been the case in the change over from the clean weeding to forestry methods in rubber cultivation. It is clearly the duty of Health Officers, stimulated, not only by the crying need of improved nutrition amongst the masses, but also, by the special needs of war, to encourage this sanitary revolution and to see that the work is carried out safely and expeditiously.

## THE AGRICULTURE ASPECT

The importance of composting is intensified by war conditions.

The war has had a profound effect in hastening the effort which is being made in Rural Singapore to alter sanitary organization in such a way as to produce the greatest possible amount of compost, as quickly as can be done. Composting is now being carried out in three large village centres drawing supplies from about 10,000 inhabitants, yielding approximately three tons of crude compost daily. Arrangements are being made to extend the system.

Meanwhile certain areas of waste land near Health Department Coolie lines have been occupied ; over fourteen acres of this land are already being cultivated for the production of vegetables and fruit.

At the beginning it required considerable persuasion to induce the labourers to carry out this work in their spare time, after working hours, without extra pay.

The first of these vegetable and fruit garden allotments, to start cultivation, was begun in the third week of October, 1939 ; others followed in quick succession. The first crops were gathered in within two months ; these,

consisted mainly of kangkong, spinach and beans. Later, supplies of tomatoes, lettuce, cucumber, radishes, chillies, ground nuts, pumpkins, bringals, ragi, tapioca and sweet potato began to arrive ; and now, within six months of planting a bumper crop of papaya is about to be gathered in.

The produce is shared amongst Health Department labourers. At the present rate of production it is estimated that over 200 of them are saving at the rate of 20 cents a week as a result of their daily ration of vegetables. Thus within six months, vegetable production is benefiting the labour force at a rate of over $ 2,000 a year. What the increase in health and vitality of the labourers is going to be remains still to be computed.

The cost of composting is no greater than cost of incineration and the capital cost of the compost pit is very considerably less than that of a village incinerator.

The local staff of the Agricultural Department have been closely associated with this work and, but for their cordial assistance, this fine achievement on the part of the coolies could not have been accomplished.

There is evidence on all sides that this development is being watched with growing interest by the villagers, many of whom are now getting busy on their own allotments. The slogan " For Health and Victory grow your own Vegetables and Fruit ", is finding practical expresssion in the clamour for more and more supplies of compost by the would-be Chinese and Tamil gardeners. The Eurasian village community, and even the Malays, are joining in this hubbub ; there are signs that school teachers are awakening to the possibility of making the local schools gardens something more than mere show places. These developments are all of very recent date.

## LOCAL EXPERIMENTS IN COMPOSTING

The period of two years, preceding the outbreak of war, was taken up with the study of the methods by which composting of village refuse and nightsoil might be well and safely done. This necessitated tests not only from the chemical, as well as the parasitological standpoint but also involved attention to the aesthetic aspect of the process.

There have been many doubts to overcome and many difficulties and disappointments to face ; there are doubtless many more adversities and adversaries to face before one can hope to establish this practice of composting on a firm, self-supporting and healthy basis.

From the parasitological point of view it has been necessary to ascertain the degrees of safety in the various systems which are practicable in this country. Temperature records have been made throughout the testing period and temperature readings are now being taken regularly under practical field conditions. The highest temperature recorded was 168°F and the lowest 142°F ; these temperatures are maintained in the compost heaps for at least three weeks, during which time the compost is being turned and all fly maggots living in the surface of the heap are thereby killed. Thus the margin of safety is considerably greater than that which has been proved sufficient in dealing with sludge in Singapore.

It has been determined that the nightsoil used in making compost is literally teeming with ascaris eggs ; it is also heavily contaminated with hookworm eggs. By the end of the third week, the compost is free from intestinal worm eggs.

Smell is a factor to be reckoned with, but I find that with increasing experience of the method, this objectionable feature, which is common to all concerns where nightsoil is manipulated, can be reduced to a minimum.

Indeed, I believe that, by seeding the nightsoil pails and buckets with compost, it will be possible to reduce the smell nuisance almost completely. It may, moreover, be possible, by this means, to introduce a saving in the present extravagant use of antiseptic fluids. These are points which must remain for subsequent confirmation. It should be observed however that the presence of either flies or odour in any composting scheme is an indication of defective work. Composting depends for its success upon the elimination of flies and smell.

The chemical results of village composting in Singapore have so far been poor. Nitrogen is recorded at the rate of only 0·73 per cent. and Phosphates, in the experimental samples, occur only in negligible amounts. These figures were so disappointing, in comparison with the Indian results, that, in the latter stages of these preliminary experiments, I was in doubt as to whether it would be worth while continuing an apparently thankless task. I am glad to report that field tests are beginning to show that the purely laboratory approach to the problem was misleading. Either there was something wrong with the sampling or, as now appears more likely, small scale experiments did not suffice to establish the full effects of the chemical process involved in composting. The Agricultural Department in Singapore have now started a field test in their experimental agricultural station. It is confidently expected that these tests will bear out the view that the compost produced on a large scale from village refuse in Singapore is of great manurial value.

The following is a brief summary of two methods of composting village refuse and nightsoil which have so far proved to be practicable and safe under the local conditions prevailing in Malaya.

## THE "CALCUTTA" METHOD OF COMPOSTING AS USED IN SINGAPORE

A battery of brick-lined trenches, twelve feet long, four feet wide and two feet deep, are constructed. Channels, formed of loose bricks, are so laid, beneath the trenches, as to provide amply for drainage and aeration. (For specification see Journal of Royal Sanitary Institute, Vol. LIX., No. 4, October, 1938.)

2. An appropriate amount of refuse is dumped daily into successive trenches. One trench may, if necessary, be used for two days' supply of refuse. The refuse is sorted ; bottles, tins and other incombustible materials are taken out and put on one side for subsequent disposal.

3. The sorted refuse is spread loosely over the surface of the trench. A layer of about six to ten inches is required. The refuse is drawn up towards the side and sloping end of the trench, so as to form a hollow into which the nightsoil is to be dumped.

4. Crude nightsoil (undiluted with water) is poured direct from nightsoil pails on to the layer of refuse. About one gallon of nightsoil is required for each cubic foot of refuse.

5. Immediately after adding the nightsoil, the refuse is thoroughly mixed, using a long rake. The coolie stands on the edge of the trench. The mixture of refuse and nightsoil is then drawn into a heap to one end of the trench where it is left undisturbed for a week. No watering is done. In very wet weather a loose layer of attaps is used to protect the heap from excessive moisture.

6. At the end of a week (during which time seven other trenches will usually have been similarly filled) the rubbish is turned and is drawn over to the other end of the trench where it is left to mature for two weeks. It is then removed and stacked in a heap on an earth floor, preferably under cover, for a further two weeks, by which time it is ready for use.

Thus, at the end of the fifth week, a continuous daily supply of humus becomes available for agriculture. The whole process, when properly carried out, is free from fly-breeding. Maggots may occasionally be observed at the surface of the heap, but these are killed after the first turn. The trenches are so constructed as to prevent the escape of maggots. The average temperature recorded during the first two weeks is at 145°F. At the end of this period the temperature gradually falls to normal. The occurrence of smell, except at the time of dumping nightsoil, is not more than that which is normally associated with an efficient septic tank.

## THE "INDORE" METHOD OF COMPOSTING AS USED IN SINGAPORE

Well drained land, free from flooding, is suitable for this method of composting. The area required is pegged and levelled. Plots of suitable size are marked out and defined with shallow earth drains.

2. Village refuse is stacked loosely in heaps. These heaps should not be less than six feet wide at the base, four feet high and four feet wide at the top. The volume of a heap 6 feet × 4 feet × 4 feet is reckoned as representing 96 cubic feet of refuse. Glass, tins, coconut husks, stones, and other incombustible material are sorted out and put on one side for subsequent disposal.

3. A trench, four feet long, two feet wide and two feet deep, having a cubic content of 16 cubic feet, is dug out in the centre of a heap of the standard size. This trench is filled with well-stirred crude nightsoil. The top of the trench is then covered over loosely with refuse drawn from the side of the heap.

The quantity of nightsoil filling the trench should equal about one-sixth (14 per cent.) of the volume of the heap. For ready reckoning each nightsoil pail full represents three gallons; approximately one gallon of nightsoil is added to each cubic foot of refuse.

4. The heap is left undisturbed for a week, except for a daily moistening with about six gallons of water in dry weather. No watering is done during wet weather.

5. At the end of the first week the heap is turned so that the outer portion of the heap becomes the inner and the rubbish inside the heap forms the outer covering. A trench three feet long, two feet wide and two feet deep is dug along the centre of the heap which is by this time reduced to about four-fifths of its original volume. Twelve cubic feet of crude nightsoil (twenty-five

nightsoil pails full), equal to about one-tenth of the volume of the standard heap, is added. The top of the trench is then again covered over with drawn refuse. Watering is continued, as before, daily in dry weather.

6. The turning of the compost heap, as described above, is done, again at the end of the second week and trenched along the centre. The same quantity of nightsoil is again added.

7. At the end of the third and fourth weeks the heap is again turned but no more nightsoil is added. Daily watering is discontinued. The heaps are now left to mature for one month. In the event of heavy rain a loose covering of grass (lallang) or coconut fronds is laid over the heaps.

Two months from the commencement of composting the heaps will have been reduced to almost one-third of its original size. The compost is then fully mature and can be used upon the land. The amount of compost to be used in vegetable cultivation depends upon the condition of the soil. In Singapore the proportion used successfully in cultivation plots has been a mixture of one part of soil to one of humus.

The Indore method requires no capital outlay on the construction of trenches, as in the case in the Calcutta method. The Indore method, however, necessitates the use of a much greater area of land and calls for much more manipulation. There is therefore a slightly greater recurring cost, though this is found to be no greater than is required for efficient incineration.

The Indore method is applicable only where the whole supply of nightsoil is available in villages or towns (*i.e.*, in villages or towns where the use of bucket latrines is universal) and where there is an ample supply of well water.

Temperature records in the Indore method are relatively higher and more prolonged than in the Calcutta system. The temperature reached in the first week averages 160°F and this heat is maintained at a high level (average 150°F) during the first three weeks.

Maggots, which may be seen at the surface of the heap, are destroyed at the first turn and do not reappear. The existence of fly breeding is evidence of inefficiency. Unpleasant odours, except at the time of applying nightsoil, are evidence of inefficient workmanship.

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# THE SOYBEAN—*GLYCINE MAX**

## INTRODUCTION

STARCHY foods, such as yams and sweet potatoes occupy too high a percentage of the peasant crops grown in this Island. Though such foods are excellent for supplying the energy requirements of a working people nevertheless something more must be sought if a community is to maintain good health by replacing muscle and fluids necessary for the proper functioning of the human body. To attain proper nutrition a certain minimum of protein rich foods must be consumed and this is true whether it be humans or farm animals. Proteins are usually supplied in agricultural communities by meat, milk and such crops as peas and beans.

In all systems of well-established peasant farming, animals feature prominently and are an essential part to the highest development of permanent peasant agriculture, but amongst the peasant agriculture of Jamaica, mixed farming as such, cannot be said to exist. Therefore, not only is the availability of milk and meat to the peasant limited and made comparatively expensive but a sound system of the maintenance of soil fertility is also lacking.

There has always been a large market for imported peas and beans, which market could be and ought to be, supplied entirely by local production. This market has undoubtedly in the past flourished largely on the popularity of red peas. Though there are numerous other varieties of peas and beans produced in Jamaica at the present time, nevertheless, red peas are the most popular and command the highest price. It is also equally true that on the whole, red peas produce undoubtedly the lowest yield per acre and are, in many instances, a gamble to grow. Not only are they limited to certain soil types, affected by the incidence of rain and drought, but they are also being wiped out on large areas of this Island through the ravages of virus diseases, more particularly, bean mosaic. Much that can be said about red peas can also be said to a lesser extent about the other varieties grown. It is therefore felt that if the production of peas could be made more attractive, not only would peasant agriculture be given an extra source of revenue, and Island diets condsiderably enhanced, but peasant agriculture would be given a sound way of maintaining soil fertility.

For protein rich foods to be easily available to the masses, any encouragement to the planter must not be made, if possible, at the expense of an increased selling price but rather through the agencies of a higher yielding bean or pea, together with the judicious maintenance of soil fertility and the economic use of artificial manures. Similarly, for the consumer to benefit, the commodity being

* By C. D. Hutchings (introduction by R. F. Innes, in *The Journal of the Jamaica Agricultural Society*, Vol. XLV.—Nos. 6 and 7, June-July, 1941.

bought by him must be of improved food nutritive value. In the case of peas and beans therefore, the great problem facing the agricultural community is to increase yields per acre without increasing cost and at the same time to produce a bean or pea of improved nutritive value.

In 1938, work was commenced on investigations leading up to the attainment of these necessities. The work was made possible by a grant from Colonial Development Funds, as a result of which, several hundred new varieties of pulse and food crops have been introduced into Jamaica from all over the world and tried out under local conditions. Arising out of these trials, it has been possible to multiply up and to place at the disposal of the planting community small samples of improved varieties of food crops of food value and yielding capabilities superior to the peasant varieties in cultivation. Amongst these crops introduced are several varieties of Soya beans.

Soya beans were introduced in Jamaica primarily for the purpose of improving the diet and agriculture of the peasant farmer. The bean is far richer than any other and by comparison with red peas, yields on the average twice as much weight of peas per acre. It is a vigorous growing crop and enhances soil fertility by the fixation of nitrogen. It could be further made to fill a prominent place in agriculture through augmenting the stock feed of the Island by being reaped in the green state and used as fodder. A general account of this crop is given by Mr. Hutchings.

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The Soybean is an annual leguminous plant, of erect, bushy habit varying in height from $1\frac{1}{2}$ to $3\frac{1}{2}$ feet. It is a native of South-eastern Asia, and its history is lost in antiquity. The first mention on record of the plant was made by the Chinese Emperor Shen-Nung about 4,800 years ago.

Fifty-three samples of seed, including forty-five separate varieties have been imported into Jamaica during the past three years from Africa, Asia, America and the East and West Indies. Some eight varieties have been selected, showing most promise, for further cultivation. In most cases, varietal samples were received in two and four ounce lots, from the produce of which 1,200 lb. of seed have already been distributed throughout the Island. A brief, tabular description of eight selected varieties appears below :—

| Variety. | Source. | Description. |
|---|---|---|
| Trinidad | Trinidad | Large, yellow, late, high yield |
| Palmetto | U. S. A. | Small, black-eye, early, high yield |
| Chinese | N. Borneo | Large, green, medium, high yield |
| Otoxi | S. Rhodesia | Medium, brown, late, moderate |
| Biltan | S. Rhodesia | Medium, black, late moderate |
| Otootan | U. S. A. | Medium, black, late, moderate |
| White Beloxi | U. S. A. | Medium, black-eye, early, high yield |
| Beloxi | U. S. A. | Large, brown, early, moderate |

On the whole, the Soybean crop is not tolerant of all the soil types occurring in the Island ; most successful crops have been grown on red limestone soil, and sandy alluvial soil ; moderate crops have been grown on heavy clay alluvial soil in some localities ; poor crops have always resulted when planting took place on

acid Inland Basin soils as occur at Wakefield, St. Catherine, or Goodhope, Trelawny, and on soil derived from conglomerate in the Blue Mountains in Portland. The crop appears to be tolerant of a considerable range in altitude, growing equally well at sea level and at two thousand feet. All other factors being equal, moisture is the factor controlling the success or failure of the Soybean crop ; experience with this crop has so far been limited to a period of three years, over widely scattered experimental areas, and, while not conclusive, that experience points to the necessity of a minimum of 20 inches of rainfall during the growth of the crop, Seasonal variation affects the crop to the extent that short-day crops planted during the period September to January will mature earlier and yield less than long-day crops planted during the period February to August.

Soybean seed will retain their vitality for rather more than a year if stored in a dry place. Stored seed appears to be far less susceptible to weevil damage than maize, cowpeas, or red beans.

There are two main types of Soybeans under cultivation in the Island at present, with an intermediate third stage. The first, represented by large, more or less, round coarse seed of varying colours from cream to chocolate, should be planted at the rate of 45 to 50 lb. per acre, or two seed 12 inches by 24 inches ; the second type, represented by smaller, more elongate seed varying in colour from black-eye, cream to black, should be seeded at the rate of 35 to 40 lb. per acre, or two seed 8 inches by 18 inches. The third type should fit in somewhere between the first two in planting rates and distances.

The Soybean, in common with other legumes, lives in close association with certain bacteria which form tubercles or bacterial colonies on the roots of the plant. The bacteria, in return for support and food provided by the plant, obtain nitrogen from the air, fixing it in a form which may be used by the plant. When Soybean seeds are planted in an area for the first time, it becomes necessary to inoculate the seed with bacteria. This is most easily accomplished by obtaining tubercles or nodules from the roots of growing plants, crushing them in milk, and wetting the seed with the mixture.

The Soybean crop requires very thorough cultivation, for weeds must be controlled to prevent competition for moisture, and a deep loose seed bed must be provided. Irrigation can be an adequate substitute for rainfall, but it is an important fact that irrigation practised immediately after planting will result in very poor germination. In the event of irrigation being necessary at planting time, the water should be laid on, and then free moisture allowed to evaporate or drain away before planting takes place, and no further irrigation should be practised until young plants have appeared through the soil. The harvesting of the Soybean crop is relatively simple, and may most easily be accomplished by snapping the plants when mature at the soil surface, and then exposing them to the sun on a barbecue or similar surface. When perfectly dry, a considerable amount of automatic shattering will take place, and this action may be completed by a light flailing.

Maximum net yields of dry Soybean seed have reached 2,000 lb. or 31 bushels per acre on irrigated sandy alluvial soil, and 1,900 lb. or 29–30 bushels per acre

on non-irrigated red limestone soil. Average yields of the most productive variety now under cultivation in the Island, namely, the " Trinidad ", may be expected to range around 1,400–1,500 lb. or 21–23 bushels per acre. The crop will mature in ten weeks, and the latest variety, " Trinidad ", planted during the long day " Palmetto ", planted on sandy alluvial soil during the short-day period, will mature in ten to sixteen weeks, depending on season and variety; the earliest variety, period will require fifteen to sixteen weeks.

The Soybean is attacked in the field, and in storage by certain insect pests and plant diseases. The leading insect pests are the Leaftier moth, *Lamprosema indicta*, a *Pyralid*, the caterpillar form of which rolls the leaves into feeding shelters and cannot be easily poisoned; the *Chrysomelid*, *Ceratoma denticolis*, of which both immature and adult forms cause injury by eating numerous holes in the foliage; and a stored grain moth, a *Pyralid*, *Ephestia* sp. the larval form of which attacks stored seed. A species of weevil, *Mulabris* sp. attacks stored seed also, to a limited extent. The leafeaters may be controlled by dusting with lead arsenate and hydrated lime in the proportions of one to six parts. Storage pests may be controlled by fumigation with carbon bisulphide; it has been found that the use of paradichlorobenzene, and naphthalene flakes for the control of storage pests impairs the vitality of the seed. A virulent, virus disease which causes discoloration and general distortion of foliage, and stunting of the entire plant occurs frequently in the field; this disease is seed borne initially, but it appears to be transmissible from plant to plant, and from plot to plot by other agencies, possibly insect vectors. Roguing, or uprooting and destruction of diseased plants is the only effective control. Failure to destroy the comparatively few diseased plants arising from infected seed will result in the probable epidemic spread of the disease. Seed stored while damp or in damp places, will almost certainly become infected with moulds and be destroyed.

The great bulk of Soybeans produced in the world are grown in the temperate climate zones, the most intensively cultivated areas of the earth's surface. The crop occupies a top rank position in modern agricultural practice, for which it depends upon the following points :—

(1) Very rich in protein.

(2) Provides the richest nitrogenous roughage adapted to most farms.

(3) Suited to many uses, and relished by most livestock.

(4) A good hay crop, fitting well in crop rotations.

(5) Has merit as a soil builder if properly used.

(6) Ranks well as a cash crop.

As food for man and feed for beast it is unexcelled in value, containing as it does 40 per cent. protein, 20 per cent. fat, and the important vitamins A, B, and D. The yield of protein, *weight for weight (1) is approximately twice that of meat, four times that of eggs, and twelve times that of milk.*

A list of food, feed, and industrial products obtained from the Soybean is given below :—

*Food Products*

| | |
|---|---|
| Soybean flour. | Vegetable shortening. |
| Refined edible Soybean oil. | Infant foods. |
| Soybean salad oil. | Diabetic foods. |
| Chocolate bars. | Oleo-margarine. |
| Sausages. | Lard substitutes. |
| Cocoa. | Filled sweets. |
| Bread. | Macaroni. |
| Muffins, cookies, doughnuts. | Soybean sprouts. |
| Soy sauce. | Soybean cheese, milk, butter. |
| Soy soup. | Soybean ice cream, biscuits. |

*Livestock Food Products*

| | | |
|---|---|---|
| Commercial feed. | Dog Chow. | Rabbit chow. |
| Dairy feed. | Chicken chowder. | Chick startena. |
| Hog chow. | Steer fatena. | Chick fatena. |
| Poultry chow. | Calf chow. | Lay chow. |

*Industrial Products*

| | | |
|---|---|---|
| Paint. | Printers Ink. | Soap. |
| Varnish. | Glycerine. | Core binders. |
| Enamels. | Celluloid. | Rubber substitutes. |
| Oilcloth. | Linoleum. | Waterproof soybean glue. |

# MEETINGS, CONFERENCES, &c.

## RUBBER RESEARCH SCHEME (CEYLON)

### MINUTES OF THE FIFTY-EIGHTH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE CHAMBER OF COMMERCE, COLOMBO, AT 2.30 P.M. ON MONDAY, OCTOBER 27, 1941

*Present.*—Mr. E. Rodrigo (in the Chair) ; Mr. C. E. Jones (Deputy Financial Secretary) ; Mr. T. Amarasuriya ; Mr. W. P. H. Dias, J.P. ; Mr. G. E. de Silva, M.S.C. ; Mr. T. C. A. de Soysa ; Mr. J. D. Farquharson ; Mr. L. P. Gapp ; Mr. F. H. Griffith, M.S.C. ; Mr. R. J. Hartley ; Mr. R. C. Kannangara, M.S.C. ; Mr. F. A. Obeyesekera ; Mr. N. D. S. Silva, O.B.E., J.P. ; and Mr. E. W. Whitelaw.

Mr. T. E. H. O'Brien, Director, was present by invitation.

Apologies for absence were received from Messrs. J. A. S. Agar ; L. M. M. Dias and E. C. Villiers, M.S.C.

**1. MINUTES**

(*a*) Draft minutes of the meeting held on July 21, 1941, which had been circulated to members, were confirmed and signed by the Chairman.

(*b*) *Matters arising from the minutes*—

1. *Supplies of sulphur.*—Reported that adequate supplies of Java sulphur are expected in Ceylon before the next refoliation season.
2. *Conference of Directors.*—Reported that the proposed Conference had been postponed until April, 1942.
3. *Advisory services to estate owners in South India.*—Reported that the United Planters' Association of South India had proposed terms on which advice by correspondence might be made available to estates in South India. It was decided to accept the proposed terms.

**2. DECISION BY CIRCULATION OF PAPERS**

*Lease of Crown land for experimental planting.*—Reported that the Visiting Agent's recommendations had been adopted by the Experimental Committee, and that application had been made for the lease of a block of Crown land at Hedigalla.

**3. DIRECTOR'S REPORT FOR 2nd QUARTER 1941**

*Wind damage.*—Reported that a large number of replies to the questionnaire regarding wind damage in young areas had been received, and that the information was being tabulated for publication in the Quarterly Circular.

*Manuring young Rubber.*—The Director explained the modified recommendations for manuring young Rubber which it was proposed to embody in a revised edition of Advisory Circular No. 2. After discussion it was agreed that the recommendations should be modified as suggested.

The report was then adopted.

**4. RESEARCH PROGRAMMES FOR 1942**

Research Programmes for 1942 were considered, and it was noted that the progress of work would depend on the availability of staff due to the international situation. The programmes were adopted.

**5. EXPERIMENTAL COMMITTEE**

Recommendations made at a meeting held on September 29, 1941 :—

(*a*) *Estate estimates for 1942.*—Detailed estate estimates for 1942, as recommended by the Experimental Committee, were approved.

(*b*) *Buildings.*—Recommendations for building construction in 1942 were approved as follows :—

| | | Rs. | c. |
|---|---|---|---|
| 1. | Quarters for Chief Budder .. .. | 2,500 | 0 |
| 2. | Improvements to Engine Driver's quarters .. | 675 | 0 |
| 3. | Manure shed at Dartonfield .. .. | 551 | 0 |
| 4. | Workshop at Dartonfield .. .. | 900 | 0 |

Estimates for the construction of labourers' cottages were referred back to the Committee for further consideration.

**6. POWER SUPPLY AT DARTONFIELD**

A breakdown of the large engine at Dartonfield was reported and it was decided, after consideration of a proposal to instal a standby engine, to ask the Board's Consulting Engineers to report on future power requirements.

**7. ACCOUNTS**

(*a*) Statement of Receipts and Payments of the Board for the quarter ended June 30, 1941, was approved.

(*b*) Dartonfield and Nivitigalakele accounts for May, June and July, 1941, were tabled.

(*c*) *Estimates of Income and Expenditure for 1942*—

Draft estimates of income and expenditure for 1942 were considered. After discussion and amendment, estimates were approved according to the following summary :—

| | | | Rs. | c. |
|---|---|---|---|---|
| Income .. .. | | | 353,884 | 0 |
| Expenditure— | | | | |
| | Rs. | c. | | |
| Revenue .. .. | 235,723 | 0 | | |
| Capital .. .. | 12,664 | 0 | | |
| | | | 248,387 | 0 |

**8. STAFF**

*Mr. R. K. S. Murray.*—Approval was given for one month's extension of leave on medical grounds.

**9. MEETINGS**

In view of the large amount of business to be dealt with, it was decided to hold six Board meetings annually, instead of the four meetings laid down as a minimum in the Rubber Research Ordinance.

Consideration of other items on the agenda was postponed and the meeting closed with a vote of thanks to the Chamber of Commerce for the use of the room.

Research Laboratories,
Dartonfield,
Agalawatta,
November 14, 1941.

## MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON, HELD AT THE CEYLON CHAMBER OF COMMERCE ROOMS, COLOMBO, ON THURSDAY, NOVEMBER 6, 1941, AT 3 P.M.

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*Present.*—Adigar T. B. Panabokke (Chairman), The Hon. the Financial Secretary (Mr. H. J. Huxham), The Director of Agriculture (Mr. Edmund Rodrigo, C.C.S.), The Chairman, Ceylon Estates Proprietary Association (Mr. C. H. Bois), Messrs. R. G. Coombe, J. D. Hoare, J. C. Kelly, W. H. Gourlay, and Dr. R. V. Norris (Director and Secretary).

1. The Notice convening the meeting was read.
2. The Minutes of the Meeting of the Board held on July 24, 1941, were confirmed.

Tabled letter from Chairman, Planters' Association of Ceylon (Mr. D. E. Hamilton), regretting inability to be present.

### 3. MEMBERSHIP OF THE BOARD AND COMMITTEES

(i.) Reported that Mr. J. C. Kelly had returned from leave and resumed his place on the Board and Finance Committee.

The Chairman welcomed Mr. Kelly and asked the Board to record their thanks to Mr. R. P. Gaddum for his services while acting for Mr. Kelly.

(ii.) Reported that Mr. S. F. H. Perera's nomination as the representative on the Board of the Low-country Products Association had expired on September 25. A new nomination by the Low-country Products Association was awaited.

### 4. FINANCE

(i.) *Institute's Accounts to September 30, 1941.*—The Chairman said the position was favourable due to good cropping and high tea sales, though receipts from the cess were still below the estimate due to delay in tea shipments.

The Chairman reported that the payments due in September on account of interest charges and capital repayments of the Government Loan had been duly met.

*Cash Position.*—The Chairman said Rs. 32,000 was on fixed deposit. This included Rs. 25,000 against loan payments due in 1942. The latter sum might be increased at the discretion of himself and the Director as funds permitted. The balance on current account at Rs. 61,038 was somewhat high but the payments against factory alterations, &c., had still to be met.

(ii.) *Subscriptions to War Charities.*—The Chairman referred to the appeal for the Merchant Services Comfort Fund and asked if a donation could not be made to this deserving cause. It was decided, however, in view of the Attorney-General's ruling that the Institute could not contribute to such Funds.

(iii.) *Estimates 1942.*—It was decided for estimating purposes to take the exportable quota for the restriction year 1941–42 at 87 per cent. of the standard crop.

**5. ST. COOMBS ESTATE**

*Visiting Agent's Report dated October 28, 1941.*—The Chairman said this report had only been received a few days ago and would be considered by the Estate and Experimental Sub-Committee on the 29th November. Meantime he invited comments.

(1) *Labour.*—The Chairman said there had been some difficulty in keeping up-to-date with routine work owing to the large amount of male labour required in connection with the factory alterations and other work on Capital Account.

(2) *Crop.*—It was reported that the estimate would probably be exceeded in spite of somewhat unfavourable weather since the monsoon began.

(3) *Soil Erosion.*—The proposals on page 3 of the Visiting Agents report would be put before the Experimental Sub-Committee.

(4) *Manures.*—Reported that the Director and Agricultural Chemist were in favour of a reduction in the amount of Phosphoric acid in the estate mixture and proposals to this effect would be submitted to the Experimental and Estate Sub-Committee.

(5) *Nurseries.*—In reply to Mr. Coombe, the Director said he thought the chief trouble was drainage. The matter was being considered by the Agricultural Chemist.

(6) *Upkeep and Cultivation.*—Page 5 of Visiting Agent's report. These proposals would be referred to the Experimental Committee.

Mr. Hoare suggested that the real cost of certain items of work could be more clearly shown if this were given in cost per acre instead of cents per pound of tea. The Director said in the monthly statements it was necessary to adhere to one system. He agreed, however, that in the estimates and reports cost per acre of appropriate items could be shown and he would take up this matter.

(7) *Factory extension and alterations.*—The Director reported the progress made in the above works which he hoped would be complete about the end of the month.

(8) *Water-borne sanitation.*—The Director said work was in progress installing water borne sanitation. He had been struck by what appeared to him the excessive size of the disposal part of the system and he thought the working of the system should be observed before further lines were converted.

Mr. Kelly pointed out that the Medical Authorities were responsible for this part of the plan.

After discussion it was decided (1) that the Government Medical Inspecting Officer might be asked to comment on the plan, (ii.) that Dr. Swenson should be asked to inspect the system when in working order, and (iii.) that provision for converting further lines should be deferred until his views had been ascertained.

(9) *Weeds and Ground Covers.*—Mr. Hoare referred to the comment of the Visiting Agent in connection with weeds in relation to ground covers and asked that this might be looked into. He also asked for information in regard to the rotation of shade trees and green manures.

The Director said in regard to shade trees it was desirable to arrange for regular replacement so that a stand of vigorous trees of suitable size might be maintained. In regard to green manures it was necessary to have a rotation to reduce the risk of heavy soil infection with pests such as eelworm, &c.

In reply to Mr. Gourlay, the Director said gliricidias did not do well on St. Coombs which was probably too high for it. In reply to Mr. Coombe, Dr. Norris said he had no objection to accacia.

(10) *Food Production.*—The Financial Secretary said he noted no provision seemed to exist for food production and asked what the position was. He thought most strongly the Institute should continue work on food production.

The Director said the only land available at St. Coombs for food production was patana and referred to the Annual Report for 1940 in which the results of the Institute's trials were given. It would be seen that these had been a complete failure though everything had been done to bring the area into good cultivation. He appreciated the importance of the subject but considered the land in question was quite unsuitable and further trials would only be a waste of money.

Mr. Hoare said the fact that chena cultivation was not carried out on the Uva patanas supported the view that patana land was unsuitable for production of the crops desired.

In reply to Mr. Gourlay who asked as to the possibilities of producing crops such as Indian corn, interplanted with tea, the Director said he did not consider this had any chance of success.

The Director of Agriculture said his Department had not experimented with patana land. He supported the Director however in his view that further trials at St. Coombs would be of little value. After further discussion the Financial Secretary said he would not press the matter further.

Mr. Coombe reminded the Director of the suggestion that Members of the Experimental Committee should have an opportunity to see the clearings, &c., before the next meeting. The Director said he would try to arrange this.

### 6. JUNIOR SCIENTIFIC STAFF

(i.) Reported that Mr. B. T. Schuiling, Field Assistant, Passara, had resigned his appointment as from 31st October and his resignation had been accepted by the Director.

It was not proposed to fill the vacancy immediately but to consider this when the question of research for the Low-country came up for discussion.

### 7. RESEARCH FOR THE LOW-COUNTRY

Reported that a circular had been issued to Low-Country Planters' Associations on this subject and the Director had arranged to meet the Associations concerned to discuss the question. A memorandum would then be prepared for submission to the Experimental Committee.

### 8. FACILITIES FOR TRAINING CEYLONESE STUDENTS AT ST. COOMBS

The Director reported that this subject had been discussed at the last meeting of the Board of Agriculture held on November 4. In accordance with the instructions of the Board he had intimated that while the Board agreed in

principle to the provision of facilities for training in research methods it was considered training in estate management could only be given on commercial estates. The Directors of the Rubber and Coconut Schemes had taken a similar line.

A resolution that training in research and estate management should be provided for Ceylonese graduates had been passed by 3 votes to 1. The further resolution that such training should be given at the three research Institutes had been defeated by 8 votes to 2.

### 9. ST. COOMBS CADDAI

The Board approved the fixing of the Institute's seal to a new agreement rendered necessary by a change of the proprietorship of the caddai.

### 10. ANY OTHER BUSINESS

(i.) *Research in the Chemistry of Tea.*—The Director reported that a further technical report had been received from Dr. Bradfield. Encouraging progress was being made.

(ii.) *Next Board Meeting.*—It was decided that the next meeting of the Board should be held in Colombo, on Thursday, December 18, a meeting of the Finance Committee being held in the morning of the same day.

The Meeting then concluded with a vote of thanks to the Chair.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle, November 10, 1941.

ROLAND V. NORRIS,
Secretary.

# REVIEW

## THE CONTROL OF WEEDS

A SYMPOSIUM of the prevention and eradication of weeds on agricultural land by cultural, chemical and biological means. Edited by R. O. Whyte and published by the Imperial Bureau of Pastures and Forage Crops as Bulletin 27 in their Herbage Publication Series.

This most useful bulletin embodies the interim results of extensive research programmes on weed control now being carried on in many countries ; it embraces work in Canada and the United States of America, Australia and New Zealand, South Africa and Germany, on the control of weeds on arable land, grass land and turf, by agronomic, ecological, biological and chemical methods. It deals with conditions in temperate or sub-tropical climates, but the principles involved are applicable to tropical conditions, and there are mentioned sufficient familiar plants to suggest that what has been successfully tackled in other countries is not incapable of solution here.

After having lived for many years in Ceylon, it is comforting to read that there is no such thing as " clean " land (particularly when the information comes from Canada) and to find that in other parts of the world too a field reported clean will produce heavy stands of weed growth, if left fallow. It is not so comforting to read claims made for the control, nay for the eradication, of weed plants such as kora, couch and illuk, that are philosophically regarded in this country as being uneradicable. It would almost appear that in Ceylon familiarity has lapsed from her usual practice and has bred content. It is certainly disturbing to read that weeds will normally be suppressed by the crop, but we are again comforted by the fact that they are not always so, even in other countries, and also by the statement that crops do not all show the same efficiency as controllers of weed growth. Lest it should be concluded that Ceylon grows all the wrong crops, it must also be stated that crop management plays a large part in weed control. In fact, cultural methods are advocated as the best means of controlling annual weeds. Cropping programmes must be planned with the object of producing a succession of vigorous crop plants, and the rotation should if possible include a crop with a large leaf surface, for light is considered necessary to weed growth, and the crop plant exercises control largely by its shading action. Not entirely ; root competition also plays a part, and the nature of the root system affects the efficiency of a plant as a weed controller. Barley, for example, is the best of all the cereals largely because it spreads its lateral roots horizontally just below the surface of the soil, occupies the inter-row spaces and depletes them of moisture, and starves out the weed seeds which germinate a few days later ; at the same time the main roots go vertically and tap the lower layers. Wheat and oats have a more sloping penetration, and the less horizontally the roots go, the less efficient are the crops as weed smotherers.

Intercultivation in the early stages of crop growth can be of the greatest value in suppressing weeds, and in America it is one of the heaviest items in the cost of raising crops like corn, cotton and beans. It is recognized that the principal value of intertillage is the destruction of weeds and that other values are incidental, if they exist at all; in consequence, it ceases as soon as the crop is large enough to take care of itself and any subsequent (small) weed growth is tolerated.

The control of perennial species is an even more urgent and difficult problem, and in some areas is threatening the very existence of crop production. It is a different problem because the roots of these plants serve not only as organs of absorption, but also of storage and reproduction, and for this reason, a detailed knowledge of the morphology and distribution of the roots is an essential preliminary to any attempt at control. For example, the perennial sowthistle (*Sonchus arvensis*) distributes its roots mostly within the first six inches from the surface, although the vertical roots may penetrate freely to a depth of six feet. The roots are very succulent and are covered with a thin and weak bark. " By applying a shallow but thorough surface tillage and preventing top-growth appearing above the surface for a period of 10-12 weeks, the food reserves stored in the roots are depleted and the roots themselves are weakened; in this condition, the thin epidermis afford the roots little protection against decomposition and they decay very rapidly. " On the other hand, the roots of field bindweed (*Convolvulus arvensis*) " possess an extremely thick corky layer in their bark, abundant food reserves, and penetrate to a depth of 12-20 feet below the surface. For these reasons, they may resist successfully a complete inhibition of their top growth for a period of one season without noticeable loss of vigour. In the second consecutive year of this treatment, they suffer noticeably, but often preserve some of their vitality even after three years ". There is obviously need for investigation in Ceylon into this question.

It is in the control of perennial weeds that chemical methods are most widely used, because it is essential that the roots of perennials are completely destroyed and this destruction is often feasible only by chemical means. Chemical control may be exercised to some extent by corrosive fertilizers—substances like Kainit and Calcium Cyanamide, which kill the weeds and then, by decomposition, become available as fertilizers. Used in this way, they are applied shortly before the crop is planted, but their use is very limited. They are effective only on young growth and their success depends entirely on the existence of favourable weather conditions; the soil must be moist for the fertilizer to decompose, but not too wet or it is diluted and becomes ineffective. Much more widely used are special weed killers which may be divided into two classes, those like iron sulphate and some copper salts which have a selective action, affecting weeds to a greater extent than cereals, and others like chlorates and arsenates which destroy all plant growth. These last are used in localities not under cultivation, such as roadsides or railway lines, and also on cultivated land in special circumstances, particularly for the eradication of deep-seated, root-propagated weeds. In America, this method is used by groups of farmers for the destruction of all noxious weeds within their district; application is made for State assistance, which is provided by gangs of unemployed labour, for which the farmers pay. Sodium chlorate was originally used, but carbon bisulphide is now becoming popular on high-priced

lands ; it is costly to apply, but one dose will kill all root growth to a depth of 18 inches within 2–3 weeks, and a crop of beans can be planted three weeks after the treatment. Chemical methods are so expensive, however, as to be prohibitive over large areas except on valuable land, and cultural methods are being more and more tried for the eradication of perennial weeds; continuous shallow cultivation has given the most promise, by preventing all growth from appearing above the soil surface and so starving out the storage organs below.

Control of weeds in grassland, either turf or pasture, is a different problem because it is necessary to tackle the weeds while the grass is there, and without injuring it. The application of sulphate of ammonia (108 lb. per acre twice a year), superphosphate (at the same rate) and lime (1,000 lb. per annum) produced in America a marked improvement in the condition of lawn turf and a marked dimunition in the weed population, and arsenical compounds proved to be more harmful to weeds than to the grass.

On grassland, regular rolling is of great importance, because it makes the soil moist, encourages tillering and helps to produce a close sward which not only suppresses the weed growth present, but also prevents the germination of new weed seeds. Of even greater value, however, is regular cropping and treading by animals, but it is essential that the grazing be controlled. "Perhaps the greatest factor in the spread or control of weeds in pastures is the system of grazing practised. Close and continuous grazing is the most fruitful method of inducing pasture weeds." (New Zealand). "The modern form of pasture management now becoming increasingly common, which consists of division into small paddocks and frequent rotation of the grazing animals together with periodic mowing, will contribute greatly to the suppression of weeds arising from the one-sided use of grassland." (Germandy). Top dressing with artificials to stimulate quick recovery of the sward after grazing and to increase the growth and density of the pasture is a vital factor in weed control. Different animals may be required to control different weeds, *e.g.* in New Zealand, sheep eradicate *Chrysanthemum leucanthemum* from a pasture, but cows won't touch it ; on the other hand, *Acaena sanguisorba* will be kept under control by cattle but neglected by sheep. The weeds should be grazed and not neglected, and maximum benefit will be obtained if they are grazed when they are making their main development ; if the process is persevered with, the weeds will probably give up the unequal struggle. In particularly stubborn cases chemical methods may be necessary, or perhaps burning, but a fire must develop sufficient heat to destroy all seed capsules and to roast any seed shed on the ground. In extreme cases it will be necessary to plough up the pasture and to resow it after a period of use as arable land ; in these circumstances, plant sociological data will be of great value in compounding the seeds mixture.

The length of this review is perhaps the best tribute to the value of the bulletin. Much has not been mentioned, but it must be obvious that this publication will repay study by all agriculturists.

# ANIMAL DISEASE RETURN FOR THE MONTH ENDED OCTOBER 31, 1941

| Province, &c. | Disease | No. of Cases up to date since Jan. 1, 1941 | Fresh Cases | Deaths | Recoveries | Balance ill | No. shot |
|---|---|---|---|---|---|---|---|
| Western | Foot and mouth disease | 101 | 29 | 1 | 77 | 23 | — |
| | Piroplasmosis | 1 | — | — | 1 | — | — |
| | Rabies | 22 | 3 | 6 | — | — | 16 |
| Colombo Municipality | Foot and mouth disease | 894 | 34 | — | 894 | — | — |
| | Rabies | 40 | 2 | 40 | — | — | — |
| | Haemorrhagic Septicaemia | 1 | — | — | 1 | — | — |
| Cattle Quarantine Station | Foot and mouth disease | 5 | — | — | 5 | — | — |
| | Anthrax | 8 | — | 8 | — | — | — |
| Central | Foot and mouth disease | 5 | — | — | 5 | — | — |
| | Piroplasmosis | 4 | — | 1 | 3 | — | — |
| | Contagious Abortion | 1 | — | — | — | — | 1 |
| | Rabies | 53 | 2 | 9 | — | — | 44 |
| | Bovine Tuberculosis | 6 | — | — | — | — | 6 |
| | Blackquarter | 30 | 18 | 30 | — | — | — |
| Southern | Foot-and-mouth disease | 43 | — | 2 | 41 | — | — |
| | Rabies | 15 | 2 | — | — | — | 15 |
| | Haemorrhagic Septicaemia | 53 | — | — | 53 | — | — |
| Northern | Foot-and-mouth disease | 248 | — | — | 248 | — | — |
| Eastern | Foot-and-mouth disease | 65 | — | 6 | 59 | — | — |
| | Rabies | 12 | — | — | — | — | 12 |
| | Goat pox | 4 | — | 2 | 2 | — | — |
| North-Western | Mange | 9 | — | 1 | 8 | — | — |
| | Anthrax | 24 | — | 24 | — | — | — |
| | Rabies | 10 | 1 | — | — | — | 10 |
| | Piroplasmosis | 3 | — | 2 | 1 | — | — |
| North-Central | Haemorrhagic Septicaemia | 43 | — | 43 | — | — | — |
| Uva | Anthrax | 85 | 54 | 85 | — | — | — |
| | Blackquarter | 13 | — | 13 | — | — | — |
| Sabaragamuwa | Rabies | 6 | — | 3 | — | — | 3 |
| | Piroplasmosis | 4 | — | — | 4 | — | — |

Department of Agriculture,
Peradeniya, November 21, 1941.

M. CRAWFORD,
Deputy Director (Animal Husbandry) and
Government Veterinary Surgeon.

3——J. N. A 7936 (11/41)

# METEOROLOGICAL REPORT, OCTOBER, 1941

| STATION | TEMPERATURE | | | | HUMIDITY | | Amount of Cloud | RAINFALL | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Maximum | Difference from Average | Mean Minimum | Difference from Average | Day | Night (from Minimum) | | Amount | No. of Rainy Days | Difference from Average |
| | ° | ° | ° | ° | % | % | | Ins. | | Ins. |
| Agalawatta .. | 86·1 | +0·3 | 73·8 | +1·3 | 82 | 95 | 6·4 | 24·81 | 28 | — |
| Anuradhapura .. | 89·1 | +0·3 | 74·8 | +1·4 | 74 | 95 | 7·2 | 8·35 | 19 | — 1·42 |
| Badulla .. | 83·9 | +0·9 | 67·0 | +1·6 | 69 | 95 | 5·4 | 10·15 | 19 | + 0·43 |
| Batticaloa .. | 87·4 | +0·3 | 76·6 | +1·4 | 73 | 86 | 5·4 | 6·57 | 17 | — 0·50 |
| Colombo .. | 86·1 | +1·3 | 76·0 | +1·2 | 74 | 86 | 6·8 | 15·20 | 22 | + 1·95 |
| Diyatalawa .. | 77·3 | +0·9 | 62·2 | +1·6 | 76 | 94 | 6·7 | 10·32 | 23 | + 0·81 |
| Galle .. | 83·7 | +0·7 | 76·5 | +1·1 | 83 | 91 | 6·6 | 17·29 | 27 | + 5·66 |
| Hakgala .. | 70·9 | +0·7 | 57·5 | +2·1 | 79 | 92 | 7·9 | 16·69 | 23 | + 3·89 |
| Hambantota .. | 87·0 | +0·8 | 76·8 | +1·6 | 78 | 86 | 6·4 | 9·77 | 14 | + 4·95 |
| Jaffna .. | 86·0 | +0·4 | 78·3 | +0·8 | 81 | 89 | 6·2 | 11·36 | 16 | + 1·78 |
| Kandy .. | 85·2 | +1·2 | 69·9 | +1·3 | 79 | 92 | 8·1 | 13·96 | 25 | + 3·09 |
| Kurunegala .. | 87·8 | +0·4 | 74·6 | +1·5 | 77 | 93 | 7·8 | 15·57 | 23 | — 0·27 |
| Lunuwila .. | 86·7 | +1·0 | 75·5 | +1·2 | 81 | 95 | 6·6 | 9·19 | 20 | — |
| Mannar .. | 85·9 | —1·4 | 78·7 | +1·4 | 79 | 86 | 8·6 | 5·57 | 12 | — 1·42 |
| Nuwara Eliya .. | 68·5 | +0·6 | 53·8 | +2·0 | 84 | 94 | 8·8 | 9·28 | 23 | — 1·36 |
| Puttalam .. | 87·3 | +1·1 | 77·5 | +2·1 | 78 | 89 | 7·0 | 5·93 | 15 | — 2·15 |
| Ratnapura .. | 87·6 | +0·4 | 74·5 | +1·8 | 84 | 95 | 7·7 | 26·64 | 28 | + 8·80 |
| Talawakele .. | 75·5 | +2·4 | 60·0 | +2·3 | 81 | 94 | 7·6 | 11·84 | 24 | + 1·69 |
| Trincomalee .. | 87·6 | —0·2 | 76·8 | +1·2 | 76 | 88 | 6·7 | 10·84 | 21 | + 1·70 |

The rainfall for October was above average over the greater part of the Island. Deficits of 2–5 inches occurred at about a score of stations, about half of which were in the western low-country between Colombo and Kurunegala. Excesses of over 10 inches were recorded at a number of stations in the south-west and in the hill-country.

Outstanding excesses were 19·19 inches at Morawaka, 16·71 inches at Carcbilmally, 16·47 inches at St. Leonard's, 16·11 inches at Lunugala and 16·08 inches at Udahena. The only deficits over 5 inches were Bibile 5·84 inches, Orwell 5·37 inches and Point Pedro 5·01 inches.

The largest monthly totals were Udugama 39·76 inches, Maliboda 37·96 inches and Kenilworth 37·18 inches, while about a score of other stations, nearly all in the south-west of the Island, also recorded totals of over 30 inches for the month.

Altogether 47 daily falls of 5 inches and over were reported, of which the majority occurred on the 4th and 22nd. The largest falls were 9·40 inches at Udahena on the 22nd and 7·92 inches at Kalutara on the 4th.

A moderate westerly or south-westerly pressure gradient persisted well into October. During the period 4th to 8th, the weather came under the influence of a depression which formed in south-west Bay of Bengal and moved up in a north-westerly direction to the Indian coast. Heavy rain occurred on the western sea-board and low-country during the initial stage of the depression.

During the second half of the month, however, the predominant feature of the weather was the more or less even distribution of pressure and the resulting scattered thunderstorm development.

Temperatures were about consistently above average. The highest shade temperature recorded was 95·2 at Anuradhapura on the 15th, while the lowest temperature was 47·8° at Nuwara Eliya on the 17th. Humidities were generally above average by day and about average by night. Cloud amounts were in excess. Surface winds were consistently above average strength, the direction being variable.

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